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Technology Insertion (TI)/Industrial Process Improvement (IPI) Summary Report for OO-ALC/Optical Repair. This document contains Focus Study and Quick Fix Recommendations for three Resource Control Centers (RCC's). These RCC's are: LIPAA, LIPAB & LIPPP
Also includes Simulation Modeling Info for these RCC's

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INDUSTRIAL PROCESS IMPROVEMENT ENGINEERING SERVICES PROCESS CHARACTERIZATION TASK ORDER NO. 18

VOLUME IV
OO-ALC

CONTRACT SUMMARY REPORT
30 JANUARY 1991

A-1

CONTRACT NO. F33600-88-D-0567
CDRL SEQUENCE NO. 18A009

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PREFACE

This report summarizes the findings and recommendations of the McDonnell Douglas Missile Systems Company (MDMSC) Industrial Process Improvement (IPI) team performing Task Order No. 18 at Ogden Air Logistics Center (OO-ALC). All work was performed as per the Task Order No. 18 Statement of Work (SOW), the IPI general SOW, and the MDMSC Task Order Proposal. The period of performance was 06 August 1990 to 30 January 1991.

During the performance of this task order, Integrated Organizational Development (IOD) was implemented at OO-ALC. The result of IOD is that the Directorates were realigned along product lines. Further, each Directorate will now function as an independent cost center responsible for its own contract administration, material management, and engineering. Management changes were made to complement the realignment of the Resource Control Centers (RCCs).

This report will present an overview of the current operations in the RCC, which should help the new management team recognize the value of the proposed process improvement recommendations. These recommendations will enable the RCCs to reduce operating costs, reduce inventory, and improve product quality under the concept of Total Quality Management (TQM).

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TASK ORDER NO. 18
PROCESS CHARACTERIZATION

EXECUTIVE SUMMARY

Task Order No. 18 of the Air Force Industrial Process Improvement (AFIPI) Program was completed by McDonnell Douglas Missile Systems Company (MDMSC) in January 1991. The task involved performing a process characterization of the Photonic Product Lines at Ogden Air Logistics Center (OO-ALC) which comprise Resource Control Centers (RCCs) LIPAA, LIPAB, and LIPPP (formerly MAKPRA).

The purpose of this task order was to identify improvements that would enhance Photonic's ability to compete against other Department of Defense (DoD) Depots and private industry. This will be accomplished by exceeding customers' standards while reducing costs and inventory, creating additional capacity for new workload, and securing the present workload with the current resources. In today's environment of reduced military spending, each RCC must trim cost and inventory while meeting throughput demands.

The major finding of this task order is the lack of accountability at every level of the organization. The result is an increase in labor costs, inventory, and rework and a decline in quality.

In an open letter to the work force on Air Force Logistics Command's (AFLC's) Quality Program (QP4), General Charles C. McDonald, AFLC Commander, highlighted the need for more responsibility and accountability at the process owner level. The lack of accountability in these RCCs creates several problems that impact their well-being. All of the effects have one thing in common: increased unit cost. Below are the problems associated with the lack of accountability and their effects on the repair cycle.

LACK OF ACCOUNTABILITY

PROBLEM	EFFECT	RESULT
* Complacency	No interest in improving process, increased touch labor time	Higher cost, loss of workload, increased flow time

* Lack of process control	Poor quality, customer dissatisfaction, increased flow time, part shortages	Increased inventory and cost, customer dissatisfaction, loss of workload
* Part Shortages	Increased flow time, increased work process, cannibalization	Increased inventory and cost, decreased quality, loss of workload
* Poor Quality	Customer dissatisfaction, premature failures, high rework	Higher cost, loss of workload, increased flow time
* High rework	Customer dissatisfaction, increased touch labor	Higher cost, decreased capacity, increased flow time

MDMSC/Industrial Process Improvement (IPI) recommends implementing the methods associated with Total Quality Management (TQM) on-going process improvement in LIPAA, LIPAB, and LIPPP. The TQM process will enable the RCCs to meet their goals of reducing operating cost, reducing inventory cost, and increasing throughput capacity for additional workload.

TQM is defined as meeting customer satisfaction through first time quality. Customer satisfaction is defined as achieving the highest quality at the lowest possible cost. Three key elements of TQM are:

- Disciplined systems and processes
- People-teams and partnership
- Supportive cultural environment

Disciplined systems and processes represent the way in which work must be done. Systems and processes refer to the steps needed to produce a product. While a high-quality product is the ultimate goal, achieving this at the lowest possible cost means

that the RCCs will have to continuously improve the process, the steps that create the product.

The word "disciplined" refers to the need for consistently following standards in the process. The RCCs lack the disciplined systems necessary to measure quality improvements. They do not have customer feedback to establish quality parameters or measure quality performance, nor do they collect rework data for individual operations except for the Picture Imaging Quality Test Facility (PIQTF). Without rework data, measurable quality parameters cannot be established, analyzed, or improved. Even the logbook data collected by PIQTF is not used to determine the cause of the defects, analyze the cause, initiate corrective action and monitor the corrective action for its effectiveness.

The RCCs do not schedule end items to effectively utilize the manpower and equipment resources to produce a smooth flow of end items. With their present documentation – Work Control Documents (WCDs), Technical Orders (TOs), Process Orders, Manufacturer's Specifications, etc. – the step-by-step instructions are lacking which ensures that end items are repaired the same way every time. Such instructions would reduce variations in the process that cause quality defects.

These problems add to the operating cost of the RCC. It is impossible to determine how much these problems cost per year because no systems are in place to collect the data to make the analysis.

People-teams and partnership is another key element in TQM. People have to participate in TQM to make it a success. Teams will need to be developed around processes to gain the expertise necessary to make continuous process improvement work successfully. People must understand that making process improvements is an important part of their jobs. Job performance should be based on their efforts to continually improve the processes.

Teams are essential because TQM requires knowledgeable people to evaluate how a change in a particular operation will affect the total process. Everyone needs to be partners in process improvement, including management, technicians, process engineers, and support personnel. Teamwork is vital because process improvements

can be accomplished easier by a group than by individuals. The RCCs presently lack teamwork, as evidenced by the absence of any on-going process improvement activities.

The other key element to TQM is a supportive cultural environment. At present, the RCCs place no emphasis on process improvement. As perceived by the technicians, no message has been communicated that a process improvement (and the resulting cost reduction) is essential to survive in today's environment of cost-consciousness. If management fails to convince the technicians that TQM is vital to the RCCs' survival, TQM will not succeed in accomplishing its objectives.

The above problems associated with the three key elements of TQM are discussed in Paragraph 7.1. Detailed solutions are addressed in the Quick Fix Plan (QFP).

Creating an attitude change so that TQM can be accomplished will not be easy, but it is absolutely essential to the long-term stability of these RCCs as the defense budget shrinks. The successful TQM efforts of Westinghouse, Motorola, and Globe Metallurgical, winners of the Malcolm Baldrige National Quality Award, were analyzed to gather information that would be helpful in implementing TQM.

For all three companies, the fundamental objective was to improve the quality of their products. They defined improved quality in customer's terms. All had different methods of achieving the improvements, indicating that there is no single, cook book recipe for becoming a world class producer. However, there were several aspects of their efforts that were almost identical. These common, hence critical, aspects will be briefly discussed herein. Complete summaries of their efforts are contained in the Database Documentation Book (DDB) for this task order.

Management leadership was the most critical element in each effort. Improving quality took continual involvement by top management at very detailed levels.

Management efforts were directed to these general categories:

- Creating the desired culture
- Planning the course of action to take

- Communicating the plan and progress
- Creating a climate of personal accountability

Once management defines and begins to establish a common mission of improving quality throughout the organization, it must measure progress. Three measurement characteristics were common in all three companies. First, the customer's desires drive the measures selected. Second, each of these world class companies chose the goal of reducing throughput time. By incorporating this measure, many other very desirable objectives are achieved, such as reducing inventory and work in process levels, reducing delays and eliminating rework and scrap. As a result, more work could be done without additional factory space, equipment, or manpower. The third common measurement characteristic was the belief that it was absolutely essential to collect data, analyze it, trend it, implement corrective action and display results. There was no pretense of improving without working to accomplish these three objectives.

Organizational performance data at all levels is monitored and reported by prominently posting indicators and trends at all locations and work sites. Bulletin boards and electronic lobby display boards are used extensively. At the shop level, daily and weekly trends are posted accordingly. Regularly scheduled production meetings are used to promulgate timely messages to all employees on progress toward goals. Regardless of the practices used, regular reporting and feedback will always be as necessary as personal accountability for progress.

It is important to realize that when they started on the road to improvement, none of these companies was willing to settle for small progress. For example, Motorola plans on a tenfold improvement in two years and 100 times improvement in five years. These improvements are not limited to merely the final product quality, but apply to every action the company takes to make its product.

Based upon the experiences and practices of the Baldrige Award winners, several recommended starting goals are offered for these RCCs which can be attained within two years.

- Customer satisfaction
- 50% reduction in process times for end items
- 50% reduction in flow times for end items

- 50% reduction in rework for end items
- 50% increase in throughput capacity
- 50% reduction in cost

As demonstrated by the Baldrige Award Winners, these goals are attainable and more ambitious goals should be set to continue the process of ongoing improvement.

Within AFLC, similar results have been demonstrated by Directorates that have implemented TQM. Sacramento Air Logistics Center (SM-ALC) Directorate of Distribution has increased its overall productivity by 70% since implementing TQM ("Jump-start your Team for Quality," Management Focus). Warner Robins Air Logistics Center (WR-ALC) Directorate of Communications - Computer Systems demonstrated a 57% decrease in Cyber reruns, 50% reduction in small computer downtime, and 76% decrease in base telephone system console failures, and three Process Action Teams (PATs) have identified nearly one million dollar combined savings/cost avoidance in a two-year period.

MDMSC/IPI can see no reason why LIPAA, LIPAB, and LIPPP cannot attain similar results. Ogden Air Logistics Center has the reputation of being a leader among the Air Logistics Centers (ALCs) in innovations, as stated in the WR-ALC Quality Report.

The most important fact to remember is that Total Quality Management on-going process improvement is a long-term process with well-defined and measurable goals. It is an investment, not a cost. If TQM on-going process improvement is not implemented in the RCCs and the cost of repairing end items is not reduced, the probability of the workload being repaired elsewhere is greater in today's cost-conscious environment.

However, the RCCs should not attempt to implement TQM alone. The Baldrige Award winners employed the help of outside TQM specialists to help write an implementation plan, establish measurable data to be collected, analyze the data, recommend, implement, and monitor solutions, and monitor the on-going effectiveness of TQM. Globe Manufacturing and the Wallace Company employed American Supplier Institute and Sanders and Associates, respectively, to help develop, implement, and monitor TQM on-going process improvement. Also, SM-ALC Directorate of Distribution

employed the Rand Corporation as a consultant to help develop, implement, and monitor TQM on-going process improvement. The advantage of outside TQM specialists is that they demonstrate managements' seriousness about TQM and help avoid pitfalls by using others' experiences while reducing the biases to on-going process improvement.

This report discusses in detail the As-Is operation of the RCC. An assessment will be made detailing what the RCC is doing well, where problems exist, and the impact of these problems relative to operating cost, inventory levels, and throughput capacity. Solutions to the problems will be presented as Quick Fixes in the Quick Fix Plan or as Other Observations in this report.

7.0 INTRODUCTION

This report summarizes McDonnell Douglas Missile System Company's (MDMSC's) process characterization of three Resource Control Centers (RCCs), LIPPP, LIPAA, and LIPAB at Ogden Air Logistics Center (OO-ALC), Hill Air Force Base (HAFB), Utah. This process characterization was performed in accordance with the applicable general Statement of Work (SOW), Task Order No. 18 SOW, and the MDMSC Task Order No. 18 proposal. The task order was completed on 30 January 1991.

It should be noted that prior to the implementation of Integrated Organizational Development (IOD) in October 1990, the three current RCCs were considered one RCC, MAKPRA, which was divided into four subunits, MAKPRA(G), MAKPRA(H), MAKPRA(J), and MAKPRF(E). Since the "MA" symbols were in use at the start of the task order, they have been used exclusively in this Contract Summary Report (CSR). The changes in organization have no impact on the thrust of this RCC assessment.

The task involved performing a process characterization of MAKPRA, Optics and Photographic Repair and the supporting subunit, MAKPRF(E). MAKPRF(E) was regarded by the Air Force (AF) as an appendage of MAKPRA(J) and is treated as such in all facets of the process characterization. All of the subunits were modeled as one entity. These units work in conjunction to produce complete camera systems and replacement components to support systems still in the field.

A summary of each of these subunits follows:

MAKPRA(G) - AIRCRAFT AND GROUND PHOTO EQUIPMENT

This subunit repairs camera systems and ground photo equipment. This includes items such as cameras, light tables, stereoscopes, projectors, and associated controls, magazines, and equipment.

MAKPRA(H) - INFRARED CAMERA REPAIR

This subunit repairs infrared camera systems, ground photo interpretation equipment, and other camera controls and equipment.

MAKPRA(J) - AERIAL CAMERA REPAIR

This subunit repairs KS87 aerial reconnaissance camera systems and all of the related subassemblies.

MAKPRF(E) - OPTICAL REFURBISHMENT

This subunit refurbishes and manufactures lenses for camera systems. This involves such processes as grinding, finishing, and coating.

Process characterization included an industrial engineering assessment of current production processes and the development of a computer simulation model database which approximates those processes.

The engineering assessment of current processes considered workload, equipment, methods, work force, facilities, and support systems. Industrial Process Improvement (IPI) engineers observed RCC work areas and processes. Interviews were held with technicians, production supervisors, and support personnel in planning, scheduling, engineering, and other support functions. The process of gathering assessment information was on-going throughout the task order period of performance.

The simulation model database that was constructed to represent the subunits in MAKPRA is based on approximately 80% of the overall RCC workload using the 80/20 concept described in the basic SOW. The resulting model database, using 1 July 1989 to 30 June 1990 as its baseline year, provides a benchmark against which potential process improvements can be measured. The model was used in this study to evaluate some of the improvement recommendations offered.

Throughout this report and the Quick Fix Plan, references from books, magazines, and newspapers will be used to lend credibility to the information presented. In particular, numerous quotes are used to provide support for several of the recommendations. The authors whose works are referenced are recognized authorities in their field of expertise. The knowledge of these authors should be used to support the need for change to survive in today's cost-conscious environment.

7.1 RESOURCE CONTROL CENTER ASSESSMENT

7.1.1 Description of Current Operations

MAKPRA is responsible for the repair of all the Air Force and some Navy camera systems, support equipment, ground interpretation equipment, and photo processing equipment. MAKPRA is divided into three subunits by commonality of end items.

Although the subunits meet their schedule and maintain or exceed the implied mandatory 95% effectiveness level, overtime hours worked per quarter regularly exceed 10% of the total direct labor hours worked. Logbook data supplied by the technician (Picture Imaging Quality Test Facility [PIQTF]) who acts as a final inspection for cameras revealed that approximately 40% of all the end items they handle require rework.

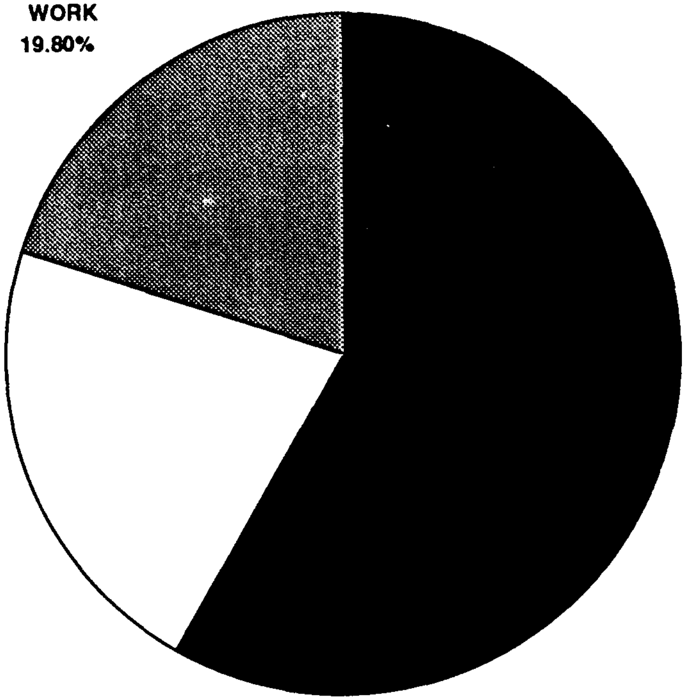
The recommendations in this report will address problems identified in the RCC and will support process improvements that will improve quality, reduce cost, reduce inventory, and meet throughput requirements with the available manpower and equipment.

7.1.2 Workload

The composition of the MAKPRA workload is summarized in Figure 7.1.2-1.

Observations concerning the workload are presented below:

- Inductions are inconsistent; the quantity and type of end items brought in vary throughout the year. Despite this variation, the number of total hours (regular and overtime) worked by the shop appeared to be fairly constant. The inconsistency of inductions does not allow for effective use of manpower and equipment. This inconsistency adds operating cost to the RCC because unscheduled overtime has to be utilized to meet quarterly workload commitments. The Universal Depot Overhaul Simulator, Version 2.0 (UDOS 2.0) "leveled inductions" experiment (Paragraph 7.2.4.1) demonstrated that the overtime worked from July 89-June 90 would not have been necessary if the end items could have been inducted equally during each quarter of the year. The benefit of levelled inductions is reduced operating cost (Quick Fix Plan [QFP] Paragraph 7.1.14).



NO. OF ITEMS

(WORKLOAD CLASIFICATION)	
MISTR	65
A-JOBS (TDY)	24
T-JOBS (TEMPORARY)	22

21004

ITEMS BY WORKLOAD CLASSIFICATION
FIGURE 7.1.2-1

- Lack of discipline on the part of field personnel results in end items arriving at the RCC that have incomplete, inaccurate or missing documentation with regard to the condition (repairability, missing parts, etc.) or mode of failure of the end item. Because of this, no relationship can be determined between the item's condition and the time that it takes to repair it. This makes it impossible to develop accurate flow times. The lack of adequate flow times makes it difficult to utilize manpower and equipment effectively, leading to bottlenecks, under-utilization of resources and unscheduled overtime. End items should be documented and analyzed so that the resource requirements can be better estimated. This will result in better resource utilization, thereby reducing operating cost (QFP Paragraph 7.1.2).

  A good example of why such documentation would be helpful is the case of end items received from the Navy. These items are often highly corroded due to the salt air environment that they operate in. Documentation of the incoming state of items will show that items repaired for both the Air Force and Navy should have standards established which are unique for each service.

- The lack of process data to establish accurate standards does not allow accurate estimation of the RCC workload capacity. Analysis of GO19C documentation revealed that 92% of the labor standards are non-engineered. Non-engineered standards do not reflect current operations. The result is that resources are under-utilized which increases the unit cost of end items.

  Observations by the IPI engineers and results of UDOS simulation revealed that end items repaired in the RCC require less time than specified in the standards. Process engineering should establish engineering standards to reflect the current operations for end items processed through the RCC (QFP Paragraph 7.1.1).

7.1.3 Repair Technologies

The majority of the end items repaired by the RCC utilize well established, mature technologies. The test and repair equipment in the RCC is sophisticated enough to support the current processes, and the technicians consistently demonstrate a solid familiarity with setup and operation.

As defined in this study, repair technology covers not only the actual repair techniques a technician uses to return an end item to like-new condition, but also addresses the following topics as they relate to process control:

- Engineering Involvement
- Accountability
- Quality Control and Assurance

In this RCC, engineering involvement is sporadic at best. Accountability is non-existent and quality control and assurance are poorly represented as well. As these three issues impact heavily on the performance of the RCC, they are detailed below.

Engineering Involvement:

Process engineers should be responsible for the orderly flow of items through the RCC. Prior to IOD, if production quotas were not met, no one would be held responsible. At best, after a lengthy investigation, blame could be affixed. The difference between affixing blame and responsibility is subtle, but it is vital. The responsible party must prevent circumstances from arising which lead to faults or failures for which blame is attached.

Process engineers, for example, do not spend much time interacting with technicians in the RCC because they have other responsibilities that receive a higher priority. Consequently, they lack in-depth knowledge about the repair processes. This delays engineered solutions and produces less than optimum solutions. This results in the under-utilization of high dollar/technology equipment such as the ring polisher and the 5500 test stands (Paragraph 7.1.7.3).

Another problem resulting from this lack of knowledge is that technicians are working from obsolete or incomplete Technical Orders (TOs) or, as in the case of the Royal Print Processor repair area, no TOs at all.

A direct consequence of this can be seen by examining the monthly foreman's report shown in Figure 7.1.3-1. Item #4 under the Production Problems section relates a process inconsistency in the PIQTF area. The technician in that area is a skilled, conscientious worker, but his TOs are obsolete and incomplete. Since there is no process engineering support, he must rely on the scant information at his disposal.

MONTHLY REPORT MAKPRAJ _ FOREMAN_ _ _ _ _ _ _ DATE APR 30, 1990

MONTHLY DIRECT LABOR HRS EXPENDED	1713
MONTHLY HRS EARNED	1415.6
DIRECT LABOR EFFECTIVENESS	82%
NEGOTIATED END ITEMS FOR QTR	291
COMPLETED END ITEMS FOR QTR	49
PERCENT OF QUANTITY END ITEMS COMPLETED	17%
QUANTITY OF MDR'S RECEIVED THIS MONTH	4
QUANTITY OF WORKMANSHIP DEFECTS RECEIVED	0

TOTAL NUMBER OF HRS USED DURING THIS MONTH

OVERTIME	0	21	168
31	205	24	31
32	82	26	527 (450 FOR TOOL CENTER)
33	8	27	90
39	0	29	0

TOTAL NUMBER OF EMPLOYEES INCLUDING FOREMAN	18
TOTAL HRS OF TEMPORARY WORK COMPLETED THIS MONTH	220

PRODUCTION PROBLEMS:

1. ATE 5500 HAS BEEN DOWN HARD FOR 8 DAYS DURING THE MONTH OF APRIL.
2. APPROXIMATELY 3 EACH DAYS FOR MECHANIC WAS LOST IN PREPARATION FOR TOOL CONTROL INSPECTION.
3. HAVE HAD TO OVERHAUL KS87 MAGAZINE AND BODY FOR THE PIQTF UNIT.
4. INCONSISTENCIES IN THE PIQTF UNIT TEST HAVE RESULTED IN PRODUCTION SLOW DOWNS.
5. KA82 CAMERA SYSTEM HAD PIQTF TEST UNIT TIED UP FOR 5 DAYS.
6. NOW HAVE 334 HOURS TIED UP IN PIQTF AWAITING FINAL TEST.

21007

SAMPLE OF MONTHLY FOREMAN'S REPORT

FIGURE 7.1.3-1

This produces unnecessary variation in final test procedures, increased flow times, and possible inaccurate test results.

Resolution of this situation needs to begin with modifying process engineering responsibilities (QFP Paragraph 7.1.1) so that their time is focused on end item repair processes and associated problems.

This will also allow the engineers the opportunity to develop a daily interaction with the technicians, who are the people most in touch with the problems of the existing process. The engineers need to actively interface with the technicians to gain the benefits of their experience. They also need to continually strive to expand their knowledge so that they can better understand how each parameter affects the process and quality.

By working with shop personnel and developing a more detailed understanding of the processes, engineers can implement changes that will convert noise factors (uncontrolled process variables) into control factors (manageable process variables). This type of control will lead to improved quality, reductions in flow and process times, and hence, lower unit costs.

Accountability:

The function of MAKPRA is to receive end items, repair them to a like-new condition, and return them to the customer. Once an end item comes into the RCC, it should pass through a number of identifiable operations in a predetermined fashion. In order to ensure that an end item undergoes the controlled processes needed to repair it in a timely fashion, someone must be assigned responsibility for that end item.

The RCC organization provides for no such person. As a result, the orderly process flow of end items exists in the RCC only in a nebulous fashion. End items travel through the RCC from workstation to storage rack at the whim of technicians who, being human, will work on the easy jobs first. The more unpleasant jobs continue to collect dust and flow time, causing unnecessarily high unit costs.

The lack of accountability is primarily attributable to the absence of what Robert H. Waterman classifies on page 8 of the book The Renewal Factor as "friendly facts,

congenial controls." The value of tight, accurate, real-time controls is not recognized and the attitude of the typical RCC worker is that these methods are management's way of keeping an eye on them.

The RCC must realize the usefulness of facts because they allow decision-making to be removed from the realm of mere opinion. A system must be developed to collect those facts (QFP Paragraph 7.1.2).

Accurate data collection will allow the RCC to identify areas for improvement, establish accountability for end items and reward superior job performance. These attributes will result in a smoother flow of end items through the RCC, thus allowing for better utilization of manpower and equipment.

Quality Control and Assurance:
As far back as the late 1800s, principles of management stated that any organization must recognize that its primary purpose is to serve the needs of others. Henry Fayol, the French engineer who wrote the book General and Industrial Management, emphasized in his 14 principles of management that the interests of society must come first. Dr. Genichi Taguchi considered society's interests to be paramount when he proposed a radical definition of quality as the loss a product causes to society after being shipped. The ideals of these two men can be directly applied to the RCC simply by replacing the word "society" with "customer."

A more modern view of the quality issue is provided by Lee Iococca. In his book Talking Straight, he states "Quality isn't something you can buy, it's something you must attain - through people. The quality improvement process is just ink on paper until workers breathe some life into the process." It is refreshing to hear a chairman of a major corporation voice this emphasis on quality. Iococca believes that quality is the lifeblood of an organization, and points out that **"everybody in an organization has to believe that their very livelihood is based on the quality of the product they deliver."** The RCC workers need to realize that their jobs depend on the quality of the products that they produce.

While there is no single cook book recipe that will guarantee quality wherever it is used, there are certain characteristics that all quality programs seem to have in common.

One key characteristic is that upper management must be actively involved throughout the program, not just at the beginning. The quality programs that have proven successful had top management continually involved at very detailed levels. It is also important that the customer's input be used to determine the measures that will be used to define what product quality is. A satisfied customer will result only when those product parameters that he deems important are being kept within limits that he has helped to establish.

Additionally, the need for good communication cannot be overstated. One of the paramount considerations of all the Malcolm Baldrige National Quality Award winners was understanding the customer's desires in specific details, not general platitudes, like "the customer is always right." This requires:

- Continuous, two-way communications with the customer at all levels of the organization.
- Time and effort to monitor and understand the customer's needs, which change as they improve their quality.
- Making each employee view every recipient of his or her work as a "personal customer."
- Measuring performance and publicizing results to customers and all employees.

Communication with customers is essential. Baldrige Award Winner Motorola representatives ask two basic questions:

> "What do you like about our work?" and
> "What don't you like about our work?"

The representative then makes detailed recommendations in writing to overcome any dislikes. Employees in each company are empowered and expected to make any changes which improve performance. It is precisely this expectation and

management's insistence on it that permitted the tremendous improvements all of these Baldrige Award winners report.

Below are listed the salient points of the MDMSC assessment of MAKPRA with regards to the quality issue:

1. The RCC does not monitor the causes of failure of repaired end items in the field. Although there is an existing Report of Discrepancy (ROD) system, it is underutilized and invisible to the RCC technicians and supervisors (see Paragraph 7.3.3.6). If this system were used properly, it could provide data to determine recurring problems. The ROD system is not used properly, however, so no one can say how the RCC is performing quality with respect to product. While it is true that you can't "inspect in" quality, it is equally true that ignoring it does not ensure its existence.

   Cycle time counters are not being reset on the end items provided with them. The result of this is that an opportunity to collect data on the mean time between failures (MTBF) of repaired items is lost.

2. Despite the existing provisions to organize Work Center Quality Circles (WCQCs) when the need arises, the IPI engineers would characterize the RCC's efforts to make on-going quality improvements in its products as feeble. The quality effort of the subunits fails primarily because no accurate baseline measures on the quality characteristics (such as the amount of scrap, the amount of rework, etc.) have been established. Without such baseline measures, no feedback on any improvements that occur in these measures can be obtained.

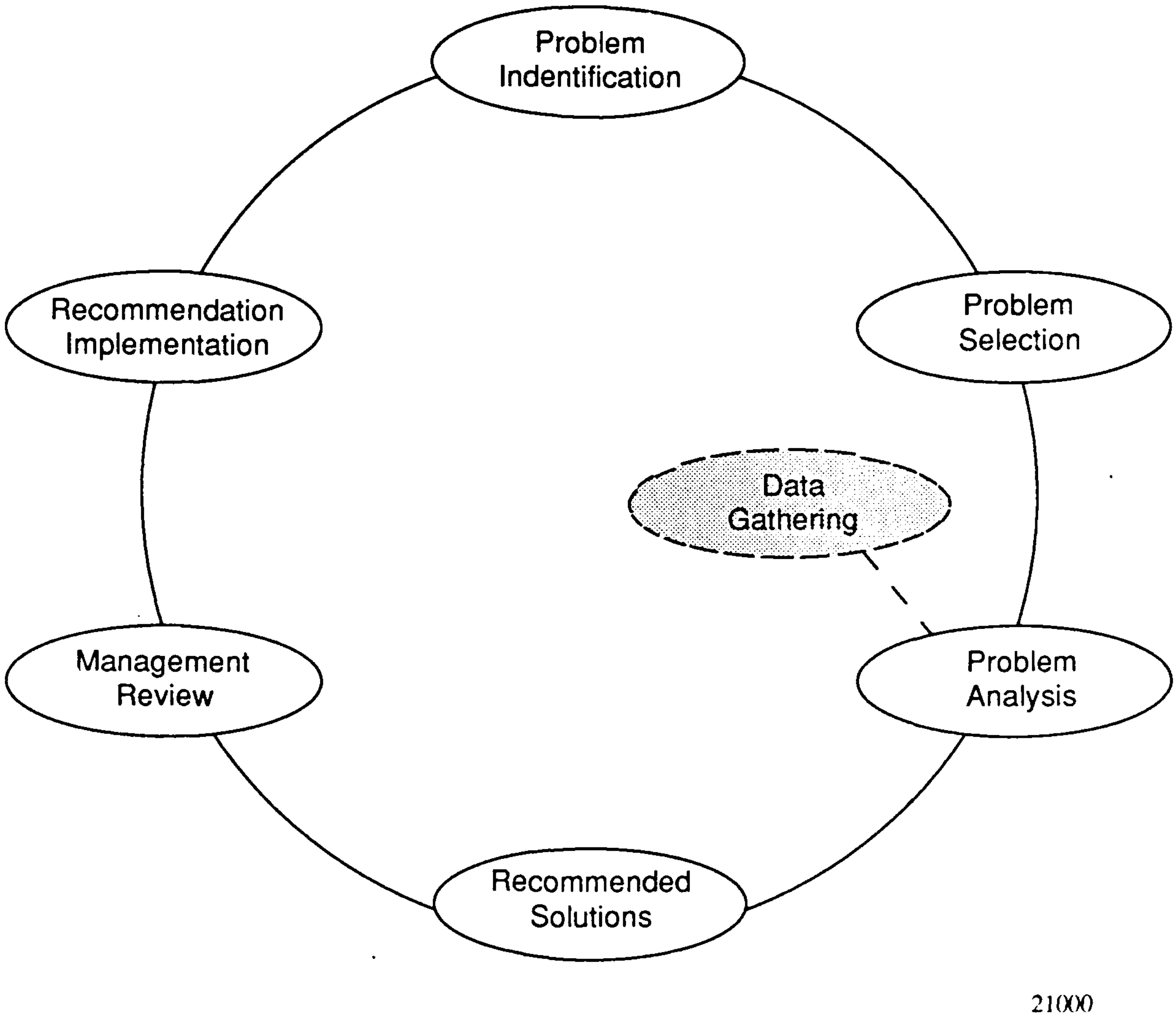
3. There does not seem to be a suitable atmosphere within the subunits to promote continuous quality improvement, especially since upper management appears to be more concerned about matters other than developing, supporting, or evaluating technical/quality issues. It is unlikely that management accurately perceives the true value of improvements made in the quality of the items produced.

4. The massive reorganization associated with IOD has created a chaotic situation. Those people dealing with quality-related functions are unsure of what they are supposed to do. The IPI engineers discovered instances where individuals were matrixed between the production and quality functions. This is a very undesirable circumstance because these functions have widely divergent goals, and it is virtually impossible for a person who has to report to both to keep everybody happy.

5. Shop personnel have little confidence in the ability of RCC middle and upper management to affect changes leading to actual improvement. Studies have been conducted which show that when there is not an atmosphere of trust, a quality improvement program is unlikely to provide any tangible benefits.

6. The success of a quality improvement program is dependent on the caliber of the people involved. The best programs get intelligent, motivated, and imaginative workers involved. As can be seen in Figure 7.1.3-2, the process of making a quality improvement involves numerous steps, the majority of which require worker input. If workers are unable or unwilling to become active participants in these steps, the chances of making significant quality improvements are slight.

   Despite attending Quality Program (QP4) classes, the workers are largely unskilled in the application of quality control techniques and strategies because they are not given an opportunity or encouraged to use what they have learned. If there was a real quality program in the RCC, technicians would use statistical process control (SPC) skills to contribute valuable inputs on how improvements could be made, or at the very least help to identify where serious quality problems exist.



STEPS INVOLVED IN MAKING A QUALITY IMPROVEMENT
FIGURE 7.1.3-2

7. The importance of continuous quality improvement has never been communicated to the workers. Consequently, they are not aware of what would be involved in such a program or what its objectives would be. The continued success of a quality control program depends on keeping people informed of its activities and successes. Quality programs are self-generating because as innovations are implemented and the workers become aware of them, the programs are embraced and the workers tend to offer suggestions of their own.

The areas observed by the IPI engineers during Task Order No. 18 are far from achieving the type of quality status demonstrated by Baldrige Award Winners, especially in view of the fact that no rigorous quality measurement systems are in place. However, the type of quality described above is certainly possible; companies have attained it.

This report has already addressed the need for the RCC to work at converting process variables from noise to control factors. Teaching the technicians quality control techniques such as SPC is a way to establish a quality database. The information will help determine whether it is worthwhile to devote resources into changing a factor from noise to control (Paragraph 7.3.3.7).

It is also important to monitor the success of the RCC's repair processes by taking every opportunity to record time between failures of end items (QFP Paragraph 7.1.7).

Improvements must also be made in documentation and data collection areas (QFP Paragraph 7.1.2), and responsibilities must be clearly defined with regard to quality control (QFP Paragraph 7.1.3).

The RCC will have to work persistently toward achieving true quality control. The by-products of reduced flow and process time and better utilization of resources will justify the effort.

7.1.4 Facilities

MAKPRA (Optics and Photographic Repair) is located in Building 100, Bay A, and is comprised of four subunits as described in Paragraph 7.0. Square footage of each subunit is as follows:

Subunit	Square feet
MAKPRA(G)	2,000
MAKPRA(H)	4,000
MAKPRA(J)	2,500
MAKPRF(E)	3,000

The RCC is currently configured to support the product line orientation of IOD. With the exceptions of paint, optical coatings, final test, and some circuit board testing, each subunit is laid out by product line. Consecutive work stations are all located in the same area, thus facilitating easy transport between operations. The general look of clutter seen in some sections of the RCC is more a result of poor housekeeping than a lack of work space.

Physical areas are all adequate with the exception of two areas:

- The first is the **processor repair area**. This area lacks proper water hook-up and drainage. To get the water needed to perform film tests, the technicians use the faucets in the rest rooms to fill up buckets, then carry the water over to the work area where it is needed. The current method is time consuming and aggravating for the technicians. By providing water outlets and a drain in the immediate work area, set-up time for film tests would be reduced. It would also reduce the risk of an accident by someone slipping on spilled water (QFP Paragraph 7.1.9).
- The second problem exists in the **optical coating lab**. Currently, lenses are coated in an uncontrolled environment that exposes the surfaces to be coated to airborne contamination. This may lead to inferior optical components (QFP Paragraph 7.1.12). This could result in the costly replacement of a camera system which would not be necessary if potential contaminants were removed from the repair process environment.

One final observation is that existing drawings of the RCC are currently obsolete or incomplete. The drawings need to be updated to provide the RCC with the information needed to plan improvements in the area.

7.1.5 Equipment

Existing equipment is adequate in both quantity and technical sophistication for the present workload. It is also noted that a Reconnaissance Modular Automated Test System (RMATS) version of the 449 Automated Test Equipment (ATE) is due for delivery in the RCC in June/July of 1991. The new equipment will support the existing workload and the Advanced Tactical Air Reconnaissance System (ATARS) workload that will arrive in 1994-1995.

Scheduled maintenance is not being performed regularly on every piece of equipment. If the personnel from the Precision Measuring Equipment Laboratory (PMEL) work more closely with the RCC personnel, a mutually agreeable maintenance and calibration schedule for the RCC's equipment could be set up. It is common knowledge in industry that a well-planned preventative maintenance program is beneficial in extending machine life and eliminating production bottlenecks caused by broken equipment. The RCC would obtain long-term benefits from the establishment of maintenance schedules for all of the pieces of equipment that need it (Paragraph 7.3.3.8).

The major equipment-related issue concerns the system for purchasing new equipment. Currently, new equipment is bought by people having little or no knowledge of the requirements of the RCC. This results in the purchase of equipment that is unneeded, therefore increasing operating cost.

The costs incurred by this are significant. For example, the RCC took delivery on 26 September 88 of a precision grinding machine to produce optical components. The cost of the machine, which included installation and in-factory training, was $501,375. This machine has not been used since its delivery because there is no work for it. The RCC has also purchased a sandblaster that cost approximately $3,300 (reference McMaster-Carr catalog) that was received almost two years ago and is neither installed nor needed as was demonstrated by the UDOS model (Paragraph 7.2.3).

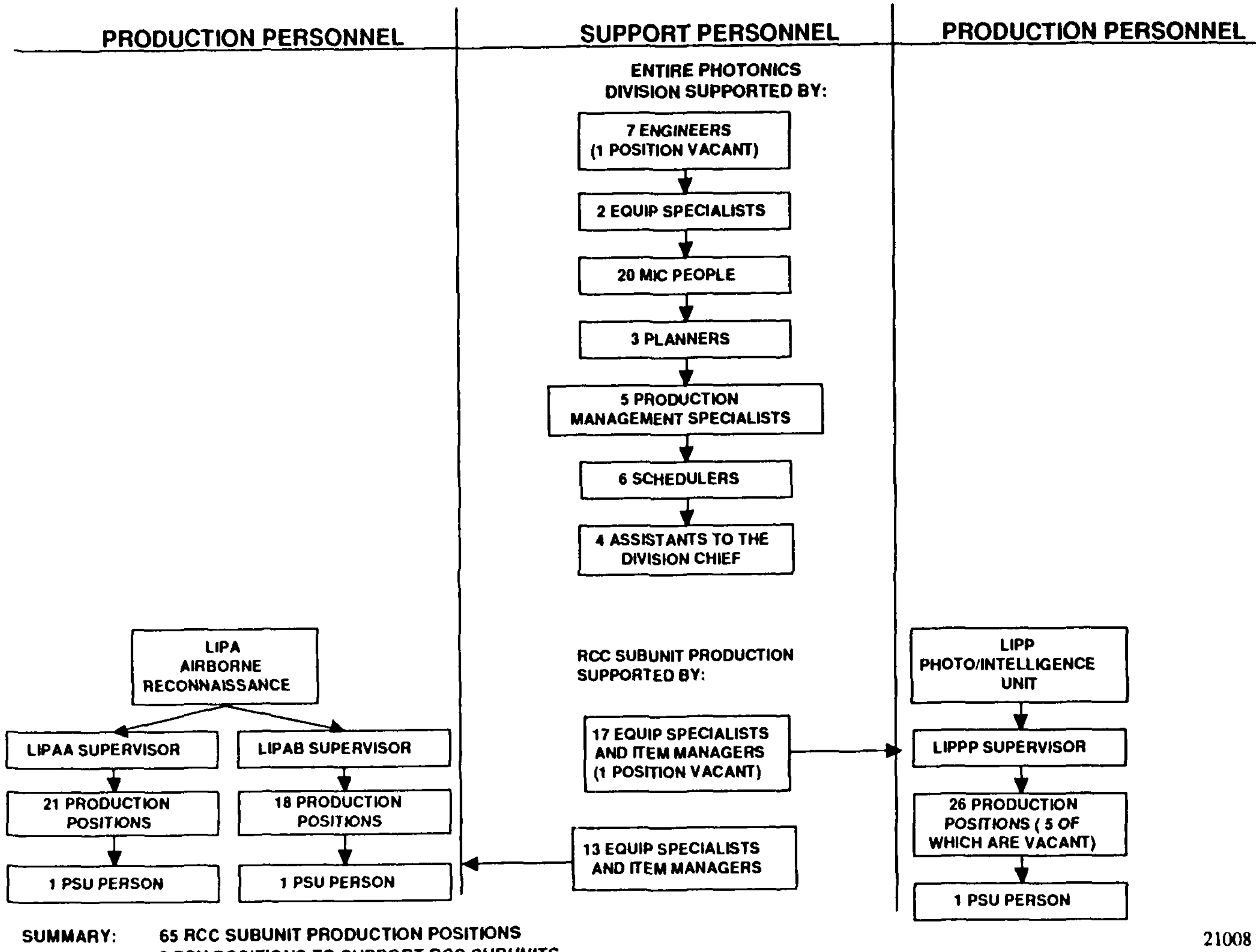
New equipment purchases should be driven by the RCC personnel most closely associated with the processes to be performed by that new equipment. Purchases should be supported by process and workload data to justify the expenditure. This would reduce the risk of unneeded equipment being purchased, thus saving the procurement cost (QFP Paragraph 7.1.4).

Observations made by the IPI engineers also revealed an improvement that could be made regarding the equipment in the RCC. The improvement would make it easier to adjust the height of the PIQTF collimator table, therefore reducing set-up time and increasing accuracy (QFP Paragraph 7.1.7).

7.1.6 Work Force

There are **63 technicians** currently engaged in the actual repair work performed by the RCC. With the exception of five wage grade (WG) employees (1-WG08, 3-WG09s, and 1-WG12), they are all WG10s or 11s. They are supported by **80 overhead employees** whose jobs include managerial, supervisory, and secretarial functions (see Figure 7.1.6-1). The overhead people also include process engineers, item managers, equipment specialists, schedulers, technical specialists, planners, project management specialists, and four people who are assistants to the division chief. This means that there are 1.27 support people for each technician in the RCC. There is no apparent reason why it should take 80 overhead people to support the shop workers. IPI engineers are unaware of any situation in private industry facilities engaged in similar processes that have a **worker** to **overhead** ratio of less than 3:1.

During the period that the IPI engineers were in the area observing the work force, certain problems were noted. The most apparent one was the complacent attitude that is prevalent among the workers.



SUMMARY:
65 RCC SUBUNIT PRODUCTION POSITIONS
3 PSU POSITIONS TO SUPPORT RCC SUBUNITS
30 EQUIPMENT SPECIALIST AND ITEM MANAGER POSITIONS TO SUPPORT RCC SUBUNITS
47 SUPPORT POSITIONS TO SUPPORT LIP OPERATIONS

LEGEND
PSU = PARTS SUPPORT UNIT
MIC = MATERIAL INVENTORY CONT.
EQUIP = EQUIPMENT

ORGANIZATION CHART FOR PHOTONICS SUBUNIT
FIGURE 7.1.6-1

An article in the 16 November 1990 "Desert News" provides a description that typifies the RCC employee:

> "Production employees would come to work in the morning at a slow, leisurely pace with a sullen or empty look on their faces. They would gradually get their coffee, wander to the tool bin and eventually get to their work station about fifteen or twenty minutes after their designated starting time. Work during the shift was at a measured pace and management spent considerable time monitoring lunches, breaks, trips to the rest room, and trying to get people to produce at a reasonable level of output. No one wanted to be responsible for anything or to spend any extra effort in problem solving or problem avoidance.
>
> It was totally different at the end of the shift. The same sullen, empty faced employees would come alive, cleaning up twenty to thirty minutes before the end of their shift, standing at the exit door waiting for the bell to leave, and walking briskly or running to their cars or trucks, laughing and talking with their fellow employees. These same people would return to their communities to be responsible leaders and volunteers. What a transformation!"

Complacency and apathy best describe the attitude most commonly observed in the RCC. There is little desire to improve the existing processes in any way. This attitude is directly attributable to a lack of performance accountability.

Utilization of employees is poor, as are employee work habits. Many employees have been observed to be idle at their work stations, socializing, or missing from their work stations during expected hours of work.

One technician confessed that two hours of actual repair work would be a productive day for him. Technicians have been observed having full breakfasts in the cafeteria during work hours. Between two and seven technicians have also been observed in

the break room for one to two hours a day bagging candy which is then resold to raise money for the Sunshine Fund. Charity is a worthwhile cause, but it should not be performed at the taxpayers' expense. Break room abuses also include post-lunch/break time card games.

The production problems attributable to this complacency became obvious to the IPI engineers shortly after the beginning of the study. The work force is unmotivated because it is not held accountable, which results in low productivity, poor use of resources, and higher operating costs. Morale also suffers as energetic employees begin to realize that "an honest day's work for an honest day's pay" is not a philosophy that has many followers. High performance, rather than bringing a technician recognition and admiration, usually brings resentment and ostracism from his fellow workers.

A number of actions are needed to overcome the complacent attitude that currently affects the RCC's competitiveness. To combat the rampant complacency observed in the RCC, the workers have to be held accountable for the work that they perform. To establish worker accountability, improved work documentation that will permit better assessment of technician performance must be established (QFP Paragraph 7.1.2). The quick fix presentation clearly details how modifications in the format and use of the Work Control Documents (WCDs) will provide RCC management with the information that is needed to fight complacency.

The battle to fight complacency must also be reflected in the work plans presented in Appendix E of the Quick Fix Plan. The responsibilities of technicians and the personnel who support them need to be expanded (QFP Paragraph 7.1.3). The recommendation in the Quick Fix Plan Paragraph 7.1.2 will only be successful if the total work force is aware of what their duties are.

The Air Logistics Center (ALC) has attempted to address worker complacency, with its most radical effort being the changes in organization structure associated with IOD.

IOD was a major Air Force Logistics Command (AFLC)-wide reorganization that affected everyone within OO-ALC. Despite high-level management commitment to change, there has been no involvement on their part since its inception that is

discernible at the RCC level. Consequently, there has been little, if any, change in the functionality of the RCC as a repair/remanufacturing facility.

The RCC is in a state of confusion after IOD. RCC supervisors reported that the only input they received on IOD-related changes was new office locations, a new organizational chart, and the directive to reorganize the RCC by product instead of process. Four months after implementation of IOD, people are still trying to find their bosses, bosses are trying to find out what to do with some of their new people, engineers don't have phones, etc.

IOD has failed to date because at the time of its conception, no one was tasked with working out the details and seeing them through. No one was accountable for either the success or the failure of the program and consequently its progress has ground to a halt. This is an ironic case where a lack of accountability is hurting the ALC's effort to successfully complete a reorganization that had as one of its objectives the establishment of accountability.

John D. Arnold, on page 121 of his book Shooting the Executive Rapids, points out a problem that occurs when organizations are restructured without adequate attention being paid to clarifying authority and accountability (as the IPI engineers believe was the case with the IOD implementation). If a reorganization does not resolve uncertainties as to who has what decision-making, decision-execution authority and how the process should be managed, the problems that plagued the production operations prior to the reorganization will still continue. ALC management failed to develop a plan that clearly defined responsibilities and goals.

There are other issues that affect work force performance. One of these is the training provided to the technicians.

The skill levels of shop technicians was generally reported to be good by subunit supervisors, but due to the lack of accurate process times or rework data, it is impossible to verify this.

Training currently is structured just to train workers in the basics of making a repair, with no emphasis being placed on familiarizing the workers with the function of the

items that they repair. Because of this, few technicians understand the "big picture" that would show why it is so critical that first-time quality be achieved in the repair processes. Without an understanding of this criticality, technicians aren't as concerned about producing a high quality item as they would be otherwise. Training should be expanded to include information on how an end item works in relation to the photo system and the importance of its function. This would help the workers understand the importance of producing a high-quality product (Paragraph 7.3.3.5). Implementation of this idea would produce a work force that would treat quality as its top priority.

The training of the RCC technicians is primarily accomplished through on-the-job training (OJT), which despite its advantages is still undesirable because improper procedures and bad work habits are often passed on to the new workers. The poor state of the existing work documentation hampers the use of printed materials for training, a condition that can be largely resolved through the implementation of the modified WCDs (QFP Paragraph 7.1.2). The improved documentation will allow WCDs to be utilized to train technicians and will help to ensure that technicians follow standardized repair procedures.

The importance of providing the workers with proper training can't be overemphasized. In the book Management and Organization, one of the factors listed on page 408 as a contributor to ineffective performance is insufficient job knowledge.

Other authors also voice the opinion that proper training is a key element in establishing and maintaining a productive work environment. As Ralph Barnes points out on page 607 of his book Motion and Time Study, "The best method imaginable for doing a given task is of little value unless the operator can and will do the work in the prescribed manner." The "can" part of this statement requires that workers receive proper training in how their jobs are to be performed. The extreme importance of training is mentioned by Thomas Gunn on pages 15-16 of his book Manufacturing for Competitive Advantage. Mr. Gunn states that continual education and training at all levels of the company is the most important element in enabling companies to gain competitive advantage in manufacturing.

The training shortcomings of the RCC are masked because the production demands on the workers are lax enough that there is usually enough time to route items to those workers who are familiar with the repair procedures for them. If the workload increased significantly the RCC would soon suffer the negative effects of an insufficiently trained work force. The quantities inducted of individual Part Control Numbers (PCNs) are generally low, so the opportunity to provide OJT is limited. Still, the RCC must be prepared for potential workload increases, so there must be emphasis placed on providing quality training on as many PCNs to as many workers as possible.

Even under the current workload, there are cases where inadequate training has created a potential for production disruptions.

The IPI engineers observed two instances where certain jobs could only be performed by a specific individual. This puts the RCC's production at serious risk because the loss of these key people will bottleneck those items that need to go through these processes. Both the coating and PIQTF areas could become production bottlenecks if the technicians currently in both areas became unavailable. An experiment was performed to evaluate the effect of having an inadequately trained technician in the PIQTF area. Results of this experiment indicated that a bottleneck occurred at PIQTF by causing a large increase in end item flow time (Paragraph 7.2.4.4).

The RCC, if it takes the preemptive action of training "backup" technicians to fill in for the "regular" technicians, will not suffer unnecessary delays when the workers who normally perform a specific repair are not available. This will result in a more consistent flow of end items through the RCC, reducing the flow times associated with repairing them.

Another observation of the IPI engineers was that the work force does not appear to be genuinely committed to the mindset that product quality is of the utmost importance. To make the technicians more responsible for the quality of the work that they perform, the AFLC implemented the Production Acceptance Certification (PAC) program. Under this program, the technicians have the responsibility of producing a quality product. A technician has to go through a training program on the repair processes that he will use on his designated end items before he is allowed to certify his own

work. Once certified, the technician stamps the WCD operation to attest that, to the best of his knowledge, the repair instructions were complied with.

The theory behind the PAC program is that quality cannot be inspected into a product. However, the PAC program makes the simplistic assumption that the workers will correct all of the defects in their work. The concept of instilling a mindset in the workers that they will be held accountable for the quality of their work is a good one only if a means for providing accountability is in place and exercised with impartial vigor. Successful companies have recognized the flaws inherent in not having independent parties conduct quality audits. None of the winners of the Malcolm Baldrige National Quality Award have displayed such an optimistic belief in their workers' quality consciousness to eliminate inspection functions. The high levels of rework in the RCC support this position and are an indicator of the failure of the PAC program in its current form.

The PAC program, despite its good intentions, represents an instance where AFLC put the cart before the horse. Because rigorous quality standards have not been established and measurement and recording techniques are not used, the PAC system effectively did away with the quality audit functions that were performed by MAQ without arranging for anyone to take over these auditing responsibilities. Without any auditing, the RCCs do not gather the valuable quality information that is needed to establish and maintain process control.

The RCCs need to make use of such techniques as SPC to detect trends in the quality of the end items being repaired. Currently, when defective items are discovered, it is not known whether they are isolated cases or an indication of a larger trend. Unnecessary operating costs are being incurred because the RCC is not tracking its processes to a detailed enough level. The technicians need to be taught SPC techniques so that detailed quality information is continuously recorded (Paragraph 7.3.3.7). This data can be used to identify problems before they impact production. The analysis of the SPC data will allow action which will reduce the RCC's operating costs.

In addition to actively applying SPC, the IPI engineers recommend that cognizant process engineers conduct quality audits to ensure that data is collected and analyzed for use in developing process improvements and reducing operating costs (QFP Paragraph 7.1.1).

7.1.7 Support Functions

The four support functions that the IPI engineers examined are scheduling, planning, engineering, and equipment maintenance. Each of these functions will be evaluated in Paragraphs 7.1.7.1 through 7.1.7.4.

7.1.7.1 Scheduling

The schedulers' main job is to see that end items are repaired by the time the customer expects them to be. They provide the supervisor with a monthly schedule which goes under the title of "Schedule/Production Foreman Report." The supervisors are also provided with a weekly hot sheet which shows all items that have attained an expedited status. Based on this sheet, supervisors know where they will need to have their technicians concentrate their efforts. Schedulers are also responsible for negotiating workloads every quarter and for tracking Mission Capable (MICAP) work through the subunits and to act as clerk for the subunits by keeping track of the hours worked. They also deliver end items to the RCC and process them out when they are complete and assist in the ordering of parts.

What schedulers do not do, despite their title, is schedule end items by serial number through the RCC. Consequently, end items move through the RCC at the discretion of the technicians. It is this situation which leads to the cannibalization of parts that produces an excess of end items in need of total repair at the end of each quarter (Paragraph 7.3.3.9).

As long as scheduling takes a reactive rather than a proactive approach to how end items are brought into the RCC, the disorganized, inefficient flow of items through the repair cycle will continue. Improved data collection and more clearly defined responsibilities will allow schedulers to better perform their functions (QFP Paragraphs 7.1.1 and 7.1.2).

7.1.7.2 Planning

Planners are tasked with the job of ensuring that the RCC subunits are provided with the latest repair technologies. They are responsible for ensuring that the necessary equipment is available for performing the required repairs.

Planners are tasked with establishing labor standards. For non-engineered standards, this is accomplished by asking the technicians how long it would take them to perform a particular task. Of the existing standards, 92.4% are of this type. Not only should a much higher percentage of standards be engineered, but process-knowledgeable process engineers should set standards. This would help reduce the amount of time technicians spend in non-productive activities. The lack of accurate labor standards is just one symptom of the lack of accountability that was previously mentioned. The planners are also responsible for monitoring the Bills of Materials (BOMs) which in many cases are incomplete.

The planners have a variety of duties and management needs to make certain that they are understood and performed (QFP Paragraph 7.1.2).

7.1.7.3 Process Engineering

See Paragraph 7.1.3.

7.1.7.4 Equipment Maintenance

See Paragraph 7.1.5.

7.2 SIMULATION MODEL

The simulation model used to process the data collected during Task Order No. 18 is the UDOS 2.0 model that was used during Task Order No. 1 to produce validated model databases for 49 RCCs across all ALCs. The model requires that some characterizing of data be done to represent the As-Is during the data collection phase. Special considerations made for the characterization of MAKPRA are discussed in the paragraphs below.

Photonics RCC:

The photonics units had very low induction numbers for workload end items during the baseline year characterized. The low quantities, spread out over four quarters, sometimes resulted in wide variances in statistical outcomes for individual items. However, the items as a group were fairly robust to variations in the model seed (refer to calculations given in Section 8.0 of the Database Documentation Book [DDB]).

The modeling of the three subunits was fairly straightforward, but the following special considerations were made:

1. MAKPRA(G), MAKPRA(H), and MAKPRA(J) were modeled as one unit due to the similarity of processes, test equipment used, and skill classifications.

2. A suffix was added to the skill code/labor grade combination that was used to represent the manpower. A letter designator (G, H, or J suffix) was used to show the particular subunit that a technician was assigned to. Designation of technicians by subunits was necessary because each subunit has its own distinct workload.

3. The manpower was further broken down to give a unique identity (WG10JF and WG11JT) to those technicians who were identified by their supervisors as being unique to specific processes (PIQTF and 5500 ATE). For detailed information on the manpower codes used in the model, refer to Section 8 of the DDB.

4. On the 80/20 list, 111 end items were identified for process characterization. Of these, 65 were management of items subject to repair (MISTR) jobs, 22 were temporary jobs (T-Jobs), and 24 were temporary detached duty jobs (A-Jobs).

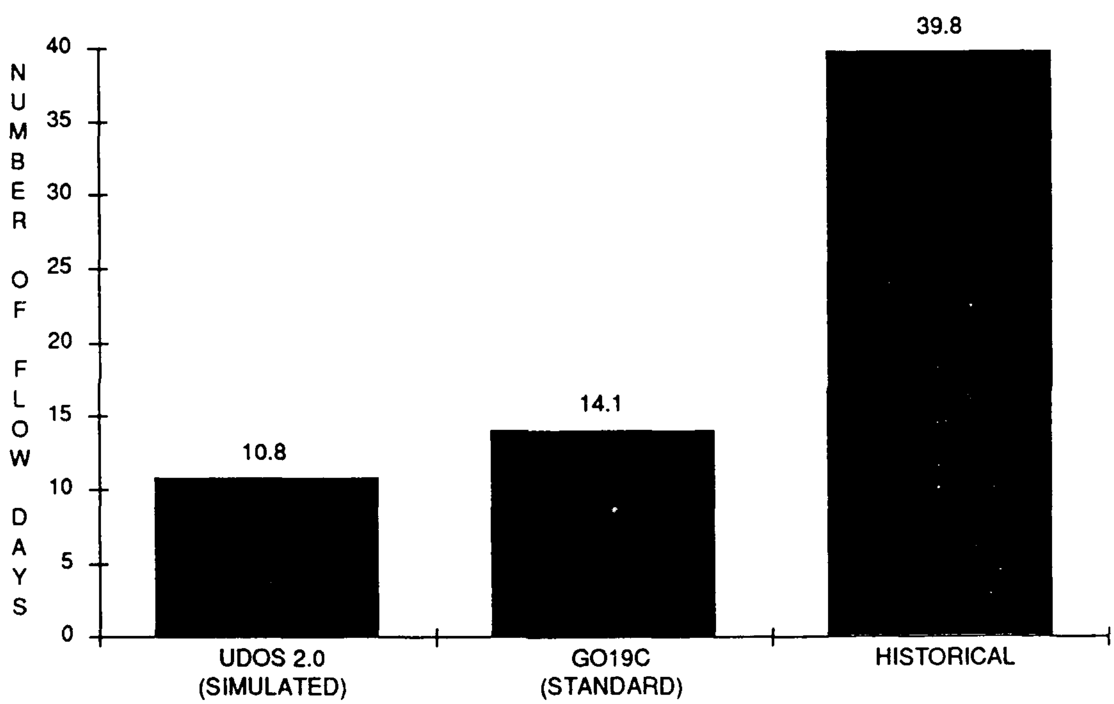
Not enough data existed on the T-Jobs and A-Jobs to accurately process characterize the end items. The detailed operation-by-operation repair data, which includes process times for manpower and equipment operations, was not available. The manpower was reduced for each subunit to account for the T-Jobs and A-Jobs hours required (per the data available). The data that was available did not include the equipment needed to perform the task. Therefore, the model data was not adjusted on equipment use to compensate for non-MISTR work.

The model outputs show that MAKPRA(G), MAKPRA(H), AND MAKPRA(J), collectively, were able to repair all of the end items that were inducted.

The queueing of items for resources in the photonics subunits was very slight, with only six resources having an average queue value (average queue quantity times average queue wait) of greater than ten. The value of ten was chosen because potential bottlenecks were starting to develop in the process at this point. Of the six resources having an average queue value of greater than 10, three (WG11G, WG10H, and WG10J) are manpower and three (PM71549, PM71848, and PM71R38) are equipment resources.

The three manpower resources mentioned above are approximately 77% utilized on the first shift as assigned, while the three equipment resources are approximately 65% utilized. Based on observation and interviews, the utilization statistics are high for both equipment and manpower for this RCC. During the interview process, it was difficult for the technician to give actual process times for operations. Instead, the technicians' times were for how long they take to perform repairs with various interruptions included. The interruptions include non-value added activities (Paragraph 7.1.6, Complacency).

The validated model flow times were compared to the calculated flow days provided by the GO19C labor accounting system and the historical flow days (Figure 7.2-1). The average flow days determined by using the model times was close to that which was calculated based upon the GO19C standards; both were much shorter than the historical average calculated from the stamped WCDs. The difference between the



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COMPARISON OF AVERAGE FLOW DAYS WHEN RCC ITEMS ARE CONSIDERED AS A GROUP

FIGURE 7.2-1

validated flow times and historical flow times has been referred to as mystery flow time. Mystery flow times can be composed of the following:

1. Time the end item is awaiting parts that are not available

2. Time the end item sits on shelf waiting to be worked by a technician after it has been stamped to enter the RCC

3. Time the end item sits after being completed before it is sold to scheduling

4. Time the end item sits at a technicians' workstation accumulating non-value added time

Based on observations and interviews it is apparent that nobody in the RCC has a clear idea of the frequency, severity, or cost of these delays. Without data it is impossible to determine the contribution due to each of the components of mystery time, so that corrective action can be initiated. The repair delays need to be documented if the RCC is to take effective action to improve its operations. The lack of understanding of the mystery flow times does not allow for efficient use of resources. The idea presented in QFP Paragraph 7.1.2 is designed to remedy the problems presently experienced because only occasional documentation is being done.

7.2.1 Brainstorming

The MDMSC/Air Force IPI engineers reviewed the data that had been compiled during the data collection/engineering assessment phase of Task Order No. 18. Using this information in conjunction with input from the RCC's engineers, the team selected three factors that were believed to strongly influence the RCC's productivity. The factors selected are explained below:

1. **Use of a Sandblaster:**
   The RCC presently has a new sandblaster that has not been installed (Paragraph 7.1.5) that could be utilized to sandblast parts, keeping them from going to a back shop. This new sandblaster has been awaiting installation for approximately two years. As typically happens when an item has to be routed to a back shop, flow time is lengthened because the priority given to items

arriving in a back shop is often lower than that given to those items processed within it. They also suffer longer flow times because of the additional transit times incurred by moving the items from shop to shop. The installation of a sandblaster in the RCC was chosen as a factor for experimentation.

2. **Amount of Rework:**
   The team determined through data collection (logbook) what percentage of the items needed to have rework performed on them after being processed through the PIQTF area. The engineers believe that steps can be taken to lower the rework percentage to 10%, and the potential effects of this were examined during experimentation.

3. **End Item Flow Time:**
   The team, upon examination of the As-Is condition prevailing in the RCC, concluded that the flow time for items repaired in the RCC could be reduced significantly by implementing various method improvements. These improvements are detailed in Paragraph 7.3 of this report and the Quick Fix Plan. By streamlining various aspects of the repair process, the group determined that a 20% flow time reduction could be achieved for the top five "high burners" processed in the RCC. This flow time reduction was selected as a factor for experimentation on those five end items which showed the highest average simulated flow hours.

These three factors were each tested at the As-Is condition and at an improved condition. The factors were fitted into an L_4 Taguchi orthogonal array. The array is shown in Table 7.2.1-1. A Taguchi array was used because of its ability to attain large amounts of information through small scale experimentation.

TAGUCHI L_4 (2^3) ORTHOGONAL ARRAY
TABLE 7.2.1-1

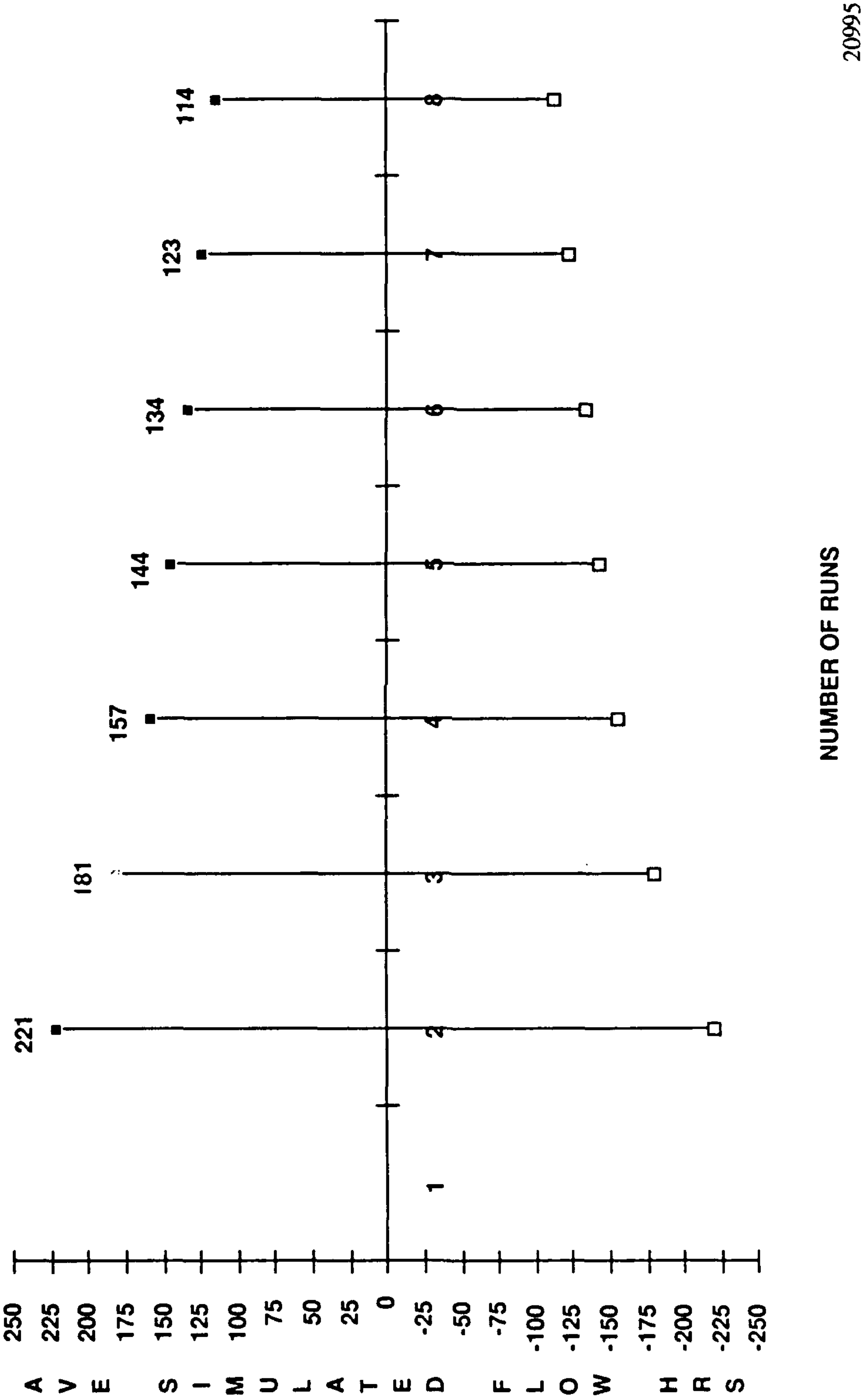
EXP. NO.	SANDBLASTER	PIQTF REWORK	END ITEM FLOW TIME
1	AS-IS	AS-IS	AS-IS
2	AS-IS	REDUCE REWORK TO 10%	REDUCE PROCESS AND BACK SHOP TIMES BY 20%
3	ADD (1)	AS-IS	REDUCE PROCESS AND BACK SHOP TIMES BY 20%
4	ADD (1)	REDUCE REWORK TO 10%	AS-IS

20994

7.2.2 Experimentation

Prior to the performance of the actual experimentation, a calculation was made to determine how many random seeds were needed to attain a 95% confidence level for experimentation. The narrowing effect of adding in more seed runs is illustrated in Figure 7.2.2-1. At a 95% confidence interval, the flow time variance attributable to random seed changes decreased insignificantly between four and five seed runs. The IPI engineers, after analyzing the data for eight random seeds for validation (refer to Section 8.0 of the DDB for the details of this analysis), determined that four random seeds were sufficient for experimentation.

The experimental runs were conducted in accordance with the SOW and the Task Order No. 18 proposal. The total number of experimental runs performed was 16 (four runs at four random seeds each). To perform the Analysis of Variance (ANOVA), the results from the various random seeds were averaged. The analysis of the model outputs was performed using average flow time, because the throughput under all experimental conditions was stable.



TASK ORDER NO. 18 VALIDATION - SEEDS ANALYSIS FOR 95% CONFIDENCE INTERVAL

FIGURE 7.2.2-1

The items that were affected relative to each of the three factors are summarized below:

Factor 1 (Sandblaster)	Factor 2 (Rework)	Factor 3 (Flow Time Reduction)
Printer A	KA56 Camera Body	KA56 Camera Body
Printer B	Lens	Printer A
Printer C	Magazine KS87	Printer B
Processing Mechanism	KS87 Body	Processing Mechanism
Royal Printer	KA56 Magazine	Royal Printer Recorder

7.2.3 Analysis

The optimum experimental combination of factor levels using Taguchi analysis (Table 7.2.3-1) was the same as that given in the second row of the Taguchi array. The optimum experimental condition yielded a 14% reduction in the average flow time per end item.

TAGUCHI ARRAY WITH RESULTS
TABLE 7.2.3-1

EXP. NO.	SANDBLASTER	PIQTF REWORK	END ITEM FLOW TIME	AVG. SIM. FLOW HRS.
1	AS-IS	AS-IS	AS-IS	361.1
2	AS-IS	REDUCE REWORK TO 10%	REDUCE PROCESS AND BACK SHOP TIMES BY 20%	310.2
3	ADD (1)	AS-IS	REDUCE PROCESS AND BACK SHOP TIMES BY 20%	319.1
4	ADD (1)	REDUCE REWORK TO 10%	AS-IS	352.5

20996

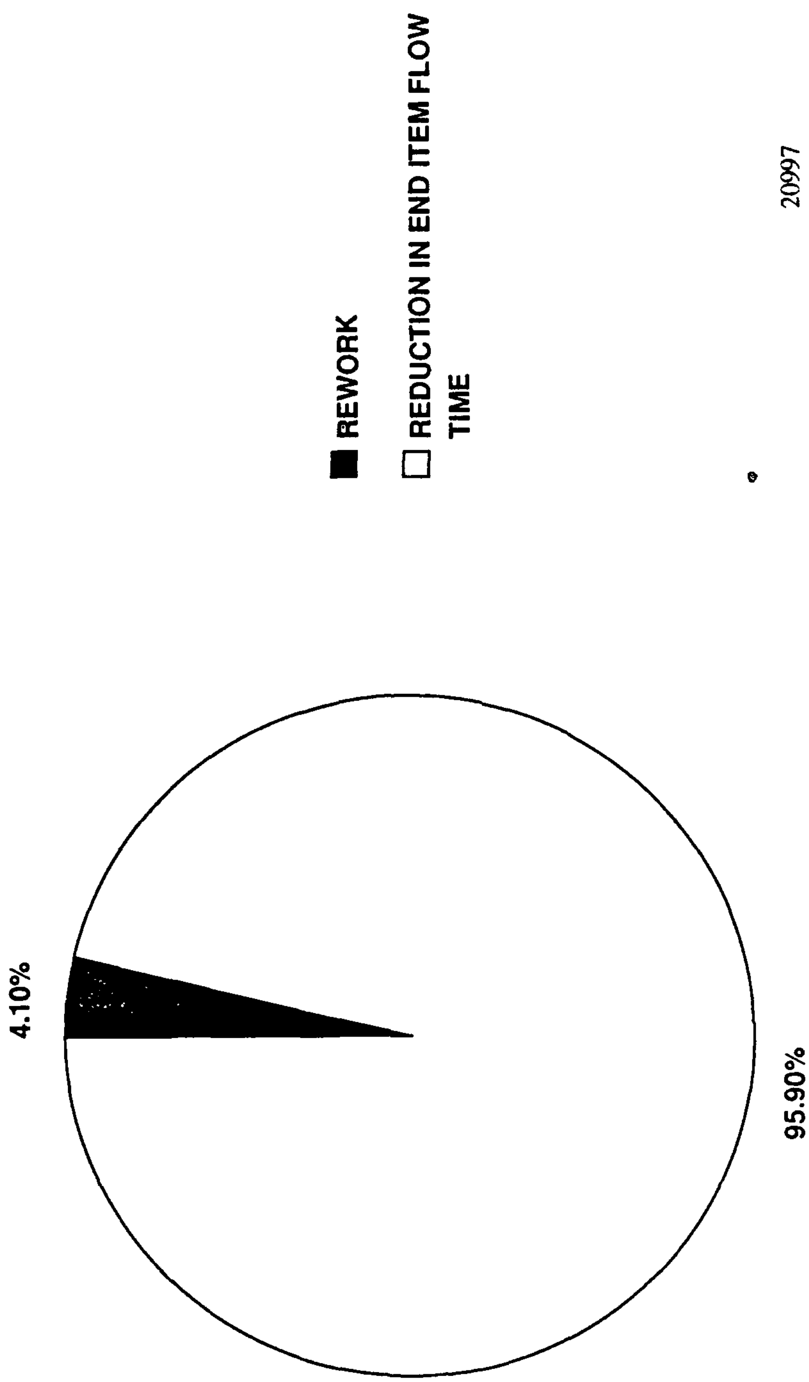
The Taguchi analysis produced some unexpected results. It was surprising that the change to perform sandblasting within the RCC did not improve the average flow time of the end items. An analysis of the outputs revealed that the change adversely affected the processing mechanism to a point that the flow time improvements in other

items were cancelled out. This situation is addressed further in Section 8 of the DDB which examines the effects attributable to each factor.

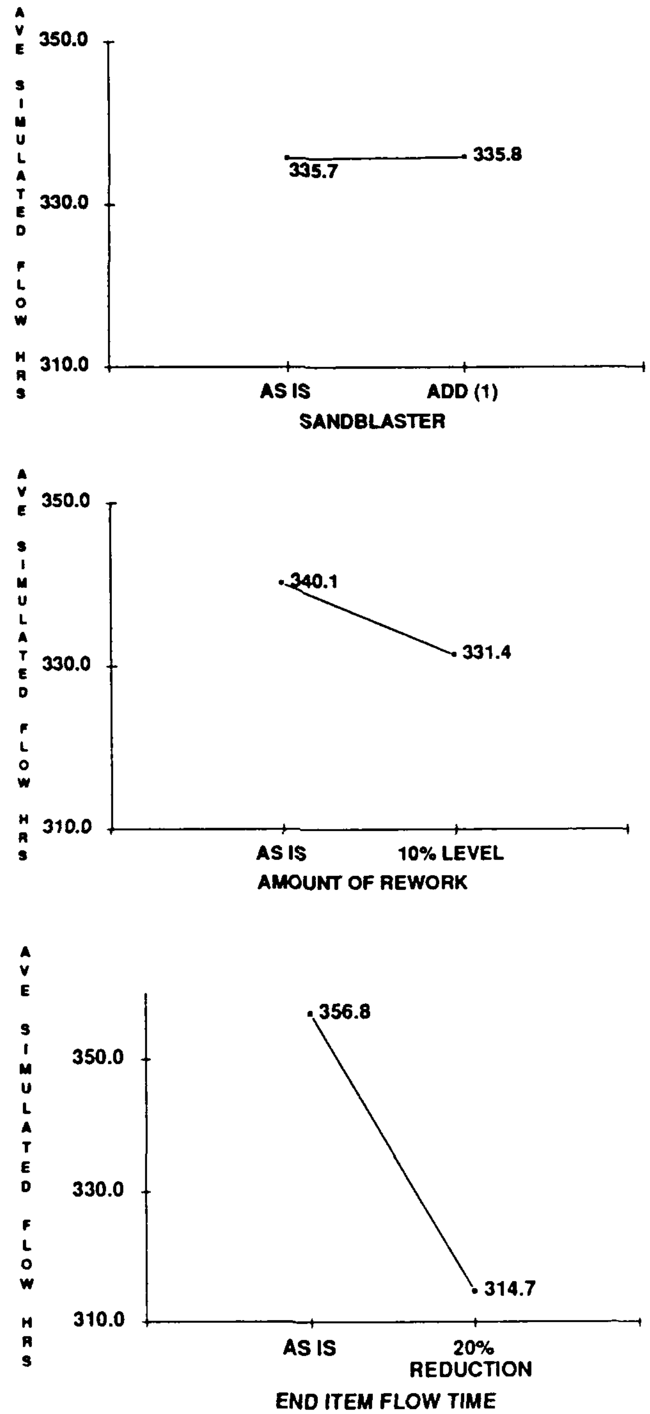
When analyzed as a group, the items showed high throughput under all of the experimental conditions, so the average flow time was selected to be the criteria to compare process changes. The third factor in this array (end item flow time) proved to be the dominant factor as its effect contributed 95.9% to the change in flow time. A 20% reduction in this factor predictably resulted in the lowest average flow times. The impact of the sandblaster and rework factors was small when compared to that produced by the reduction in end item flow time. Process improvements in the RCC should focus on end items with the longest flow times.

The ANOVA was performed using the Lab Partner software (supplied by Sof-Ware Tools of Boise, Idaho). Section 8.0 of the DDB contains copies of the outputs produced by Lab Partner. The data supplied by the ANOVA was used to create Figure 7.2.3-1, which shows the contribution percentages for each experimental factor. (Note: The sandblaster factor had a percentage of 0.)

The calculated, ([As-Is - 20% Flow Time Reduction] divided by As-Is), 11.8% reduction in average flow time per item is impressive, considering that over 2,700 inducted items were considered when making the calculations. The impact of the change made in the factors is very noticeable when the experimental results are graphed. The response averages presented in Figure 7.2.3-2 clearly show that the greatest benefits for the RCC will result from concentrating improvement efforts on those items having the highest flow time. In Paragraph 7.3 of this report, recommendations will be made for method improvements that, if implemented, would result in reductions in the end item flow time.



CONTRIBUTION PERCENTAGES OF FACTORS
FIGURE 7.2.3-1



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RESPONSE AVERAGE FOR EXPERIMENTAL FACTORS
FIGURE 7.2.3-2

The average flow times produced for each level for the three experimental factors is displayed in Table 7.2.3.-2.

COMPARISON OF FLOW TIME FOR EACH FACTOR LEVEL
TABLE 7.2.3-2

FACTOR	AVG SIM FLOW TIME		% DIFFERENCE BETWEEN TIMES
	LEVEL 1 (AS-IS)	LEVEL 2 (EXPERIMENTAL)	
ADDITION OF SANDBLASTER	335.7	335.8	0
REDUCTION IN AMOUNT OF REWORK	340.1	331.4	-2.6
REDUCTION IN END ITEM FLOW TIME	356.8	314.7	-11.8

20998

7.2.4 One Factor Experiments

As the IPI engineers gained knowledge about the RCC, other problems were identified that the engineers decided should be investigated using the simulation model. Because these problems were straightforward, it was not necessary to use the Taguchi design of experimentation to evaluate the proposed changes for experimentation.

The first experiment was designed to determine if the profiled workload could have been repaired without using overtime, provided that quarterly inductions for each item were approximately equal.

The second experiment was designed to evaluate benefits of adding a second shift to reduce bottlenecks. Pieces of equipment that appeared to be bottlenecks based on UDOS 2.0 validation results would be available to this second shift.

The third experiment combined the first two experiments to evaluate the effects of both leveling inductions and adding second shift work. Because of the non-linear nature of the UDOS 2.0 model, the results of the first two experiments could not simply be added together to determine the cumulative effect of both changes. The IPI engineers believed that it would be worthwhile to perform the third experiment to show the benefits that could be gained by working more than a single shift and better controlling the induction of items.

The fourth experiment was designed to examine what would happen if the highly experienced technician in the PIQTF area, was unavailable for a year and an inexperienced technician had to fill in for him. The pivotal role of the experienced technician in the RCC's operations is discussed in Paragraph 7.3.3.2. The experiment's purpose was to show the disruption that could occur in the RCC if the experienced technician, for some reason, was not available to perform his jobs. The RCC has been operating as if the experienced technician is a resource that will be around forever. The IPI engineers wanted to use the experiment to demonstrate the dangers of not cross training employees.

These four experiments are described in detail in the paragraphs that follow.

7.2.4.1 Experiment with Leveled Inductions

Review of the validated model outputs indicated that even though the throughput was high, there were high utilizations on only two of the manpower codes (WG10J and WG11G). This was surprising, given the large number of overtime hours worked during the time period characterized. Upon investigation, it was determined that approximately 14% of the direct labor hours worked during the year were overtime hours. The data was obtained from the monthly foreman's report. Overtime, considering the idleness that was observed, did not appear to be needed provided that a more orderly flow of inductions could be achieved. The decision was made to use the model to examine the effects of eliminating the overtime hours by leveling the inductions so that the workload of the RCC per quarter would be approximately the same.

The experiment leveled the annual inductions as evenly as possible over the four quarters. The change in inductions was accompanied by a corresponding change to level the manpower quantities assigned to each quarter. The leveled manpower quantities do not include the equivalent manpower for the overtime hours worked each quarter.

The dedicated manpower classifications (WG10JF and WG11JT) were modified so that they could perform WG10J work when needed.

The experiment showed that the workload could have been repaired without overtime and without sacrificing throughput (QFP Paragraph 7.1.14). The repair time for the items as a group decreased significantly (refer to Table 8-1 in Section 8 of the DDB). It would not have been necessary for the RCC to have worked overtime (12,442 hours) to repair the end items profiled had they been uniformly inducted. In addition to the overtime savings, there would be an annual savings of 710 labor hours (refer to Table 8-2 in the DDB). Using the overtime rate of time and a half (RCC hourly labor rate of \$43.50), the annual savings that could potentially be achieved by leveling inductions is:

$$\left(\frac{\$43.50}{hr} \times \frac{12442\ hr}{yr} \times 1.5\right) + \left(\frac{\$43.50}{hr} \times \frac{710\ hrs}{yr}\right) = \$842,726$$

The IOD concept, by structuring the ALC's repair operations along product lines, is a positive development in terms of the scheduling of items. Under IOD, the RCC will be able to determine how end items are brought in for repair.

As shown in Table 8-3 in the DDB, the leveling of inductions produced a significant reduction in the amount of work in process (WIP) as evidenced by the reduction in queue hours. The experiment showed a total reduction of 106,328 hours in the time that items spend in queues, which averages 39.5 hours per item, or 1.65 days. The WIP reduction, if the savings in carrying costs is calculated using the current prime rate of 9.5%, would produce the following annual savings:

$$.095 \text{ X } 1.65 \text{ days} \times \frac{1\ yr}{365\ days} \times \frac{2693\ items}{yr} \times \frac{\$18087}{item} = \$20,918$$

The high average cost of the items (\$18,087 per item calculated - GO19C end item stock list price) repaired in this RCC makes it imperative that the RCC try to improve its operations so that once an item is brought in for repair, it smoothly goes through the necessary operations until it is completed. Delays in the repair process result in high WIP levels and even though the technicians don't appear to view the storing of WIP items in the work area as anything out of the ordinary, the fact is that these items take up valuable work space. Successful companies recognize that there is a cost associated with excess inventory, whether it be in the form of raw materials, WIP, or finished goods. The RCC has accepted high WIP levels as a way of life, but this

mindset must be changed and the technicians need to develop a cost consciousness with regard to inventory.

7.2.4.2 Experiment with Adding a Second Shift

During review of the validated model outputs, it was noticed that several pieces of equipment had shift utilizations that were above 50%. These pieces of equipment and their utilization percentages are given below:

Equipment ID	Description	Utilization Percentage
PM71549	Test Stand	62
PM71848	Test Equipment	68
PM71R16	Test Stand	56
PM71R38	Test Bench	62
PM71R39	Test Stand	57

The engineers determined that a worthwhile one-factor experiment would be to make the equipment above available on second shift, along with reassigning the necessary manpower needed to run them from first to second shift. This change should significantly reduce the queuing of items awaiting testing. The creation of a second shift operation would not be complicated or expensive, since it would simply require the reassigning of some technicians and possible addition of a supervisor to oversee them.

The model inputs were changed allowing the five pieces of equipment to be available on second shift, along with three WG10Js and four WG10Hs (who were taken from the first shift work force). The remainder of the data was unchanged from the validated model. This allowed the results of the experiments to be compared against the validated model. The differences in outputs of the experiment and the validated model are solely attributable to the one factor changed.

A reduction of 168,981 flow hours was achieved when the manpower and equipment previously discussed was made available on second shift. The switch of resources onto second shift greatly reduced the queuing on the five pieces of equipment. The queue statistic for the As-Is condition was 25.4 hours, but it dropped to 2.3 hours for the experimental run.

The first shift utilization for the five pieces of equipment also dropped from an average of 61% to 31%. Reduced utilization of the equipment increased the idle time on first shift, but when the combined idle time for first and second shifts for the As-Is and experimental outputs were compared, little difference existed. The manpower remained highly utilized on first shift under both conditions. The assignment of manpower and equipment to second shift significantly reduced flow hours without creating excessive idleness of the resources. Past practice of the RCC has been to work only first shift (to reserve excess capacity for workload surge. This practice should be abandoned because only relatively minor changes would be needed to implement this experimental change. The assignment of seven technicians onto second shift could be accomplished without jeopardizing the RCC's capability to meet any likely surge conditions. Given these benefits, the RCC would be negligent in not investigating a second shift, especially given the low implementation cost of this change. Aside from the slight increase in labor costs that would result from paying the seven workers a shift differential, and if an existing supervisor is transferred onto second shift, there would be no other costs associated with implementing this idea.

7.2.4.3 Experiment with Leveled Induction and Second Shift Work

The third experiment was a combination of the first two (leveled induction and a second shift), with the specialized technicians (WG10JF and WG11JT) being allowed to fill in for the WG10Js. The engineers believed that it would be helpful to the RCC to know what benefits would result from jointly leveling the inductions and making the five pieces of equipment (along with four WG10Hs and three WG10Js) available on second shift.

The dual changes resulted in a reduction of 152,032 flow hours over the entire group of items repaired. This large flow time savings is in addition to the savings that would be produced from eliminating overtime. The queuing on the five pieces of equipment, as measured by the queue statistic (average queue quantity multiplied by the average queue wait), averaged a miniscule .6 hour. By levelling the inductions of end items and better allocating resources by expanding to a second shift, the RCC could make great strides toward improving the efficiency of its operations.

7.2.4.4 Experiment with Inexperienced Technicians in PIQTF Area

The IPI engineers found that the RCC's operations are at risk in those areas where there is only one fully trained technician to perform a designated task. In particular, only one technician is presently knowledgeable about the operations in the PIQTF area. This is a dangerous situation because the absence of the technician would cripple the RCC's operations. This situation is addressed later in Paragraph 7.3.3.2.

The Senior Optics Specialist employed during this task order, stated that in his opinion, it would take anywhere from twelve to 18 months to bring an inexperienced technician up to the skill level of the technician who presently does the work. The lengthy OJT period that a novice technician would need to get up to speed makes it important for RCC management to conduct such training. The IPI engineers performed an experiment to demonstrate how the RCC's operations could be hurt if the services of the present technician were lost without a substitute technician being fully trained.

The experiment was performed under the assumption that the efficiency level of an inexperienced person would be as follows:

First Quarter	-	30%
Second Quarter	-	60%
Third Quarter	-	80%
Fourth Quarter	-	80%

The experiment clearly illustrated the necessity of having a fully trained technician in the PIQTF area. Under the experimental conditions, an additional 167,632 flow hours were required to repair the items processed through the RCC during the year. The substitution of a less efficient technician made the PIQTF area a process bottleneck. The increases in the queue statistics for both the WG10JF and the PIQTF resources were compared to the validation. These statistics (which represent the average queue quantity multiplied by the average queue wait) went from 10.78 to 18.91 for the WG10JF and from .09 to 1.12 for PIQTF.

The large increase in flow hours attributable to the experimental change is a clear signal that the RCC needs to show foresight and train technicians prior to a need actually arising for their services. While there are no expectations that the

experienced technician's services will be lost anytime soon, the RCC needs to have contingency plans to prevent avoidable production problems from occurring.

Summary: The results of the one-factor experiments are summarized below:

Experiment No.	Objective of Experiment	Net Effect on Total No. Flow Hrs
1	Examine effect of leveling inductions	-104,459
2	Examine effect of reassigning seven technicians (four WG10Hs and three WG10Js) onto second shift while making five pieces of equipment (PM71549, PM71848, PM71R16, PM71R38, and PM71R39) available on both first and second shift	-168,981
3	Examine effect of jointly making the changes described in (1) and (2) above	-152,032
4	Examine effect of replacing the PIQTF area technician (WG10JF) with an inexperienced technician	+167,632

The one-factor experiments clearly demonstrated that the RCC can make simple changes that will make its operations more efficient, thereby improving its effectiveness. The experiments showed how valuable the UDOS 2.0 model can be in evaluating various production scenarios, and the RCC should strive to make use of the model in this manner.

7.3 CONCLUSIONS

The major concern of IPI engineers is the lack of process control and individual accountability in the RCC. The RCC has the manpower and equipment to ensure its continuation, but does not fully utilize those assets because process control and individual accountability are absent. Additionally, the RCC cannot improve itself until it collects accurate process data to serve as a baseline measurement.

As a result of these findings, it is considered vital that these issues be addressed in a forthright, persistent manner. Quick Fixes 7.1.1, 7.1.2, and 7.1.3 provide detailed solutions to these specific problems, and the implementation of all three is considered the crux of this task order. Without solving the problems of data collection and personal accountability, it will remain impossible for the RCC to determine effective process improvements and to document those gains accurately so that they can be used to negotiate for larger workloads.

This report raises a number of questions:

- Why is quarterly overtime consistently necessary?
- Why are the TOs outdated in PIQTF, Royal Print Processor, and coating areas?
- Why are only 7.2% of the existing time standards engineered?
- Why is there a half-million dollar machine that is unused?
- Why does a new $3,500 sandblaster sit uninstalled for almost two years?
- Why haven't the requests for tooling in the Royal Print Processor repair area been answered for over a year?

The suggestions made in Paragraphs 7.1.1 through 7.1.3 of the QFP are all inexpensive and can be implemented immediately. They should help the RCC achieve and exceed the stated goals of IOD by filling in the information void created by upper management and hopefully become an example for other RCCs at OO-ALC.

7.3.1 Focus Study Recommendations

This task order generated no Focus Study recommendations.

7.3.2 Quick Fixes

During the performance of Task Order No. 18, MDMSC sought to identify improvement opportunities which could be implemented quickly (within six months) at low or no cost

($200,000 or less). Fourteen ideas in this category were identified. They are summarized below and are discussed in detail in the Quick Fix Plan.

Process Engineering: MDMSC recommends that total responsibility, from induction to sale, for an individual PCN or group of PCNs be given to individual process engineers. This will provide a single point of contact for problems that occur with specific end items. It will also provide a body of people who will become expert with regard to the end items.

Process Control Data Collection: MDMSC recommends that existing WCDs be updated and modified so they can be used as a collection device for process and flow times. These times should be utilized by the cognizant process engineers to identify problem areas.

Modified Work Plans: MDMSC recommends that existing employee work plans be modified to reflect new data collection and process control responsibilities.

Capital Equipment Purchasing and Utilization: MDMSC recommends that working/process specifications for new equipment be written by the cognizant process engineer/engineers in conjunction with the production people who will use the equipment and their supervisor. Also, equipment currently in place in the RCC that is not used should be identified and removed from the area.

Circuit Card Stripping: MDMSC recommends the use of a plasma etching technique for stripping the sealing coat on circuit boards that are to be repaired by the RCC.

PIQTF Table Controls: MDMSC recommends that the tape measure used to indicate table height be replaced with a potentiometer/digital readout system. This improvement, along with relocating the table on/off switch, will improve the ergonomics of the system and improve the accuracy of the height measurement.

Life Cycle Counters: MDMSC recommends setting the life cycle counters of repaired end items to zero, when possible. The reading taken from these counters should be recorded on the WCD when the item comes back to the RCC. For counters that cannot be reset, the cumulative readings should be recorded. In both cases, the information

recorded could be examined by the cognizant engineer so that short service life items can be identified and the cause of their failure noted and modified if possible. This would provide the RCC with valuable data to help it concentrate its efforts on bad units.

Water Hookup: MDMSC recommends providing water hookups and a drain in the area of the 28024 process.

Test Fixtures: MDMSC recommends building fixtures to support the processor frames per the already submitted request from the subunit.

Shim Storage: MDMSC recommends storing camera mounting shims in plastic photo holder sheets and storing these sheets in a binder.

Clean Room Coating Environment: MDMSC recommends providing portable class 1000 clean room booths for the coating process equipment.

Resurfacing Pressure Platen: MDMSC recommends stripping the old paint from the platens chemically, polishing the platen on the existing glass polishing wheel and then resurfacing it with carbon activated paint or satin finish anodize.

Cathode Ray Tube (CRT) Alignment Video System: MDMSC recommends the installation of a high resolution video system in the CRT alignment room so that the technician does not have to stare through a microscope at the dangerously bright traces.

Parts Cannibalization: MDMSC recommends using the data collected on the modified WCDs to highlight where end items are delayed due to a lack of repair parts. Once this lack is identified, the cognizant process engineer should work with the parts supply people for a solution.

Leveling of Inductions: MDMSC recommends that more emphasis be placed on bringing items into the RCC on a regular basis because the current irregular method of inducting items hurts the RCC's operations. The scheduling of items must become proactive rather than reactive.

7.3.3 Other Observations

7.3.3.1 Replacement of Yellow Filter on KCB1 and T11 Cameras

Current Condition: The yellow filter on these cameras must be replaced occasionally. This part is no longer available from vendors, and when one is needed for a repair it is scavenged.

MDMSC Recommendation: It is suggested that parameters for the filter be determined through measurements taken at the RCC. Once the filter is characterized, five to ten replacement filters can be manufactured and stocked for future use. This would help reduce cannibalization.

7.3.3.2 Training in Specialized Areas

Current Condition: The two causes of concern are in the PIQTF and the coating areas. Both of these areas perform work requiring specialized skills and knowledge not readily available in either the RCC work force or the local civilian work force. Currently, there is only one man in each of these areas who is fully capable of performing all the area's tasks. The loss of either of them would result in a great reduction, if not termination, of throughput. Both of these areas are important stops for most of the end items moving through the RCC.

MDMSC Recommendations: RCC management, supervision, and the two skilled technicians should develop a training program. The goal of the program should be to produce at least one, preferably two, technicians capable of substituting for both experienced technicians. It is recommended that these new technicians be assigned full time to work with the two skilled technicians until they are qualified to perform the tasks of the given area.

7.3.3.3 Bearing Wear in KA56 Camera

Current Condition: Bearings within the puck wobble plate assembly are subject to almost constant motion resulting in excessively high rates of bearing failure.

MDMSC Recommendation: Failed bearings should be replaced with silicon nitrate ceramic bearings. Information on these bearings can be found in the DDB for Task Order No. 18.

7.3.3.4 Ion Beam Sputtering

Current Condition: Electron beam deposition is the most commonly employed method currently in use in the RCC for coating items. This technique creates films that exhibit packing densities of approximately 90% and grow in a columnar structure. When exposed to the atmosphere, the interstitial spaces will begin to fill with moisture from the air. This causes the overall refractive index of the coating to change, which in turn results in serious degradation of the optical component.

MDMSC Recommendation: High energy deposition techniques, such as the ion beam method, almost completely eliminate this effect while producing highly stable coatings with a low pinhole count.

7.3.3.5 Improved Training on Function of End Item

Current Condition: Technicians usually are unaware of the relationship of the end items repaired in the RCC to the performance of the aircraft. Because of this, end items are viewed as stand-alone items, with the technicians often being unaware of how a specific end item affects the performance, safety, etc. of the entire aircraft.

MDMSC Recommendation: Teach technicians about the *functions of the end items* that they repair, with particular emphasis on why it is important to produce a high-quality item. This knowledge would help the technicians realize how important the items are that they work on, which in turn would help improve their dedication to producing the highest-quality products that they possibly can. A thorough understanding of the purpose served by the various end items processed in the RCC would help the technicians develop more pride in what they do.

7.3.3.6 Customer Feedback

Current Condition: The ROD system serves only to get problem items back into the RCC for rework. It does not provide a tool for tracking problems to identify recurring anomalies.

MDMSC Recommendation: RCC management should take steps to ensure that existing ROD documentation is consistently and completely filled out in the field. Data from this source should then be kept on file for review by the cognizant process

engineer who will initiate and carry through actions that eliminate the cause of recurring problems identified by the ROD system.

7.3.3.7 SPC Training

Current Condition: RCC personnel are not provided with in-depth training in SPC techniques.

MDMSC Recommendation: A mandatory class providing intensive training in SPC techniques should be provided for all RCC personnel. Familiarization with these techniques will allow specific data to be collected so that repair processes can be controlled at the technician level. This should enable the RCC to provide the highest possible quality.

7.3.3.8 Improved Equipment Maintenance and Calibration

Current Condition: The lack of communication and the scheduling between Precision Measuring Equipment Laboratory (PMEL) and the RCCs results in equipment not receiving preventative maintenance. To date, this lack of maintenance has not caused unnecessary bottlenecks in the repair processes.

MDMSC Recommendation: Develop better communication and scheduling for preventative maintenance of equipment between PMEL and the RCCs. Proper preventative maintenance will help to reduce premature equipment failure and extend the life of the equipment. Maintenance will reduce the risk of bottlenecks in the repair processes. The RCC will save in operating cost because of less bottlenecks and longer replacement cycle time for equipment.

7.3.3.9 Improved Flow Through Elimination of Cannibalization

Current Condition: Technicians currently cannibalize parts from the items that need extensive repair. With the parts hoarded from these items, the currently-needed end items are repaired. This results in other end items not being repaired because they are awaiting parts. This practice does not allow the planners to determine accurately what parts and quantities are needed to repair all the end item, and can lead to long flow time.

MDMSC Recommendation: To eliminate cannibalization, the WCD format must be modified per Appendix B in the Quick Fix Plan and RCC personnel trained in its use. The new WCD establishes accountability for missing parts before the end item is inducted into the RCC. The end item cannot be inducted into the RCC without its complement of repair parts. The WCD allows for delays to be documented in the repair process. It also allows for a cause to be established so corrective action can be initiated. This data will be used to determine an accurate Bill of Material for each end item, which will eliminate long flow time for end items awaiting parts.

APPENDIX A

LIST OF ACRONYMS AND ABBREVIATIONS

LIST OF ACRONYMS AND ABBREVIATIONS

A-JOB	TEMPORARY DETACHED DUTY JOB
AF	AIR FORCE
AFIPI	AIR FORCE INDUSTRIAL PROCESS IMPROVEMENT
AFLC	AIR FORCE LOGISTICS COMMAND
ALC	AIR LOGISTICS CENTER
ANOVA	ANALYSIS OF VARIANCE
ATARS	ADVANCED TACTICAL AIR RECONNAISSANCE SYSTEM
ATE	AUTOMATED TEST EQUIPMENT
BOM	BILL OF MATERIALS
CRT	CATHODE RAY TUBE
CSR	CONTRACT SUMMARY REPORT
DDB	DATABASE DOCUMENTATION BOOK
DOD	DEPARTMENT OF DEFENSE
HAFB	HILL AIR FORCE BASE
IOD	INTEGRATED ORGANIZATIONAL DEVELOPMENT
IPI	INDUSTRIAL PROCESS IMPROVEMENT
MDMSC	MCDONNELL DOUGLAS MISSILE SYSTEMS COMPANY
MICAP	MISSION CAPABLE
MISTR	MANAGEMENT OF ITEMS SUBJECT TO REPAIR
MTBF	MEAN TIME BETWEEN FAILURES
OJT	ON-THE-JOB TRAINING
OO-ALC	OGDEN AIR LOGISTICS CENTER
PAC	PRODUCTION ACCEPTANCE CERTIFICATION
PAT	PROCESS ACTION TEAM
PC	PERSONAL COMPUTER
PCN	PRODUCTION CONTROL NUMBER
PIQTF	PICTURE IMAGING QUALITY TEST FACILITY
PMEL	PRECISION MEASURING EQUIPMENT LABORATORY
QFP	QUICK FIX PLAN
QP4	QUALITY PROGRAM
RCC	RESOURCE CONTROL CENTER
ROD	REPORT OF DISCREPANCY
RMATS	RECONNAISSANCE MODULAR AUTOMATED TEST SYSTEM
SM-ALC	SACRAMENTO AIR LOGISTICS CENTER
SOW	STATEMENT OF WORK
SPC	STATISTICAL PROCESS CONTROL
T-JOB	TEMPORARY JOB
TO	TECHNICAL ORDER
TQM	TOTAL QUALITY MANAGEMENT
UDOS 2.0	UNIVERSAL DEPOT OVERHAUL SIMULATOR, VERSION 2.0
WCD	WORK CONTROL DOCUMENT
WCQC	WORK CENTER QUALITY CIRCLE
WG	WAGE GRADE
WIP	WORK IN PROCESS
WR-ALC	WARNER ROBINS AIR LOGISTICS CENTER

INDUSTRIAL PROCESS IMPROVEMENT ENGINEERING SERVICES PROCESS CHARACTERIZATION TASK ORDER NO. 18

VOLUME IV
OO-ALC

QUICK FIX PLAN
30 JANUARY 1991

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7.0 INTRODUCTION

As a result of the process characterization of Resource Control Centers (RCCs) LIPAA, LIPAB, and LIPPP (formerly MAKPRA), McDonnell Douglas Missile Systems Company (MDMSC) has developed 14 process improvement recommendations that are presented as quick fix opportunities. Each can be implemented in less than six months for costs of less than $200,000. Table 7.0-1 summarizes the quick fixes that have a quantifiable cost savings.

The first three Quick Fixes specifically address the lack of accountability and process control that has been identified as the major issue impacting the operation of the RCC. The Industrial Process Improvement (IPI) engineers suggest the implementation of these three Quick Fixes as one entity since they are interrelated.

The remaining Quick Fixes are directed to more specific process problems and can be easily implemented on a stand-alone basis.

OO-ALC QUICK FIX RECOMMENDATION SUMMARY (TASK ORDER NO. 18)
TABLE 7.0-1 (SHEET 1 OF 3)

MDMSC RECOMMENDATION	IMPACT	ANNUAL BUDGET SAVINGS	COST AVOIDANCE			INVESTMENT COST
			FLOW TIME REDUCTION	WIP INVENTORY REDUCTION	FLOOR SPACE REDUCTION	
DEVELOP A SYSTEM FOR PLACING GREATER ACCOUNTABILITY ON THE TECHNICIANS FOR THE TIMELY REPAIR OF ITEMS	THE CURRENT LACK OF DOCUMENTATION AND TRACK ALLOWS POOR PERFORMANCE. THE PROPOSED SYSTEM WILL PROVIDE "HARD" DATA THAT CAN BE USED TO IMPROVE THE RCC'S (AND INDIVIDUAL TECHNICIAN'S) PERFORMANCE	$1,764,882	N/A	N/A	N/A	$104,748
DEVELOP A NEW EQUIPMENT PURCHASING PLAN	A PLAN WOULD PREVENT UNNEEDED EQUIPMENT FROM BEING PURCHASED	$504,675	N/A	N/A	N/A	$3,110
IMPROVE PROCESS FOR CIRCUIT CARD STRIPPING	THE PLASMA ETCH METHOD WILL SIGNIFICANTLY REDUCE THE AMOUNT OF HAZARDOUS WASTES PRODUCED	N/A	N/A	N/A	N/A	$16,960
MODIFY PIQTF COLLIMATOR TABLE TO MAKE HEIGHT ADJUSTMENTS EASIER	THE MODIFIED TABLE WILL RESULT IN BETTER ERGONOMICS AND IMPROVED PROCESS REPEATABILITY	$1,644	N/A	N/A	N/A	$728

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OO-ALC QUICK FIX RECOMMENDATION SUMMARY (TASK ORDER NO. 18)
TABLE 7.0-1 (SHEET 2 OF 3)

MDMSC RECOMMENDATION	IMPACT	ANNUAL BUDGET SAVINGS	COST AVOIDANCE			INVESTMENT COST
			FLOW TIME REDUCTION	WIP INVENTORY REDUCTION	FLOOR SPACE REDUCTION	
INSTALL A HOT/COLD WATER HOOKUP FOR THE PROCESSOR REPAIR AREA	THIS FACILITY CHANGE WILL REDUCE THE TOTAL TIME NEEDED TO PERFORM THE FILM TESTS AND IMPROVE WORKER SAFETY	$3,915	N/A	N/A	N/A	$996
BUILD FIXTURES FOR PROCESSOR FRAMES	THE USE OF A FIXTURE WOULD ELIMINATE THE NEED FOR MORE THAN ONE TECHNICIAN FOR ROTATING THE FRAMES	$979	N/A	N/A	N/A	$1,000
IMPLEMENT A SHIM STORAGE SYSTEM IN THE PIQTF AREA	THE ORGANIZED STORAGE OF SHIMS WILL REDUCE THE SETUP TIME	$4,110	N/A	N/A	N/A	$20
IMPROVE METHOD TO RESURFACE PRESSURE PLATEN	THE RECOMMENDED PROCESS WILL REDUCE THE REPAIR TIME	$30,624	N/A	N/A	N/A	$73
IMPROVE SAFETY AND DECREASE REPAIR TIME ON CRT UNITS BY USING AN ALIGNMENT VIDEO SYSTEM	BY NOT REQUIRING THE TECHNICIAN TO LOOK INTO A BRIGHT LIGHT TO PERFORM HIS JOB, THE CHANCES OF AN EYE INJURY ARE REDUCED AND HE WILL NEED TO TAKE LESS BREAKS FROM HIS WORK	$16,704	384 HRS	N/A	N/A	$3,000

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OO-ALC QUICK FIX RECOMMENDATION SUMMARY (TASK ORDER NO. 18)
TABLE 7.0-1 (SHEET 3 OF 3)

MDMSC RECOMMENDATION	IMPACT	ANNUAL BUDGET SAVINGS	COST AVOIDANCE			INVESTMENT COST
			FLOW TIME REDUCTION	WIP INVENTORY REDUCTION	FLOOR SPACE REDUCTION	
IMPROVE RCC SCHEDULING TO AVOID IRREGULAR INDUCTIONS	A MORE REGULAR INDUCTION SCHEDULE WILL LOWER THE AVERAGE FLOW TIME NEEDED TO REPAIR ITEMS AND ELIMINATE THE NEED FOR OVERTIME IN THE RCC	$842,726	104,459HRS	$20,918	N/A	$0
TOTALS		$3,170,259	104,843HRS	$20,918	N/A	$130,635

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7.1 LIPPP, LIPAA, LIPAB QUICK FIX OPPORTUNITIES

7.1.1 Improved Accountability

7.1.1.1 Description of Current Process

The term "process," when used in a manufacturing context, suggests an orderly, predetermined, documented sequence of events that occurs on a continuous and predictable basis. By this definition, there is no evidence of process control within the RCCs. A good example is the Work Control Document (WCD) for the Royal Print Processor.

The WCD should sequentially list each operation performed on an item to bring it to a like-new condition. Appendix A shows the existing WCD for the Royal Print Processor. Figure 7.1.1.1-1 shows a flow chart of the operations actually performed to repair the processor. They are not even superficially similar, which indicates a complete lack of a defined, controllable process. The fact that this end item has been repaired in an RCC for only 18 months indicates that the failure of the RCC to provide a process is not something that occurred long ago, but is happening in the present.

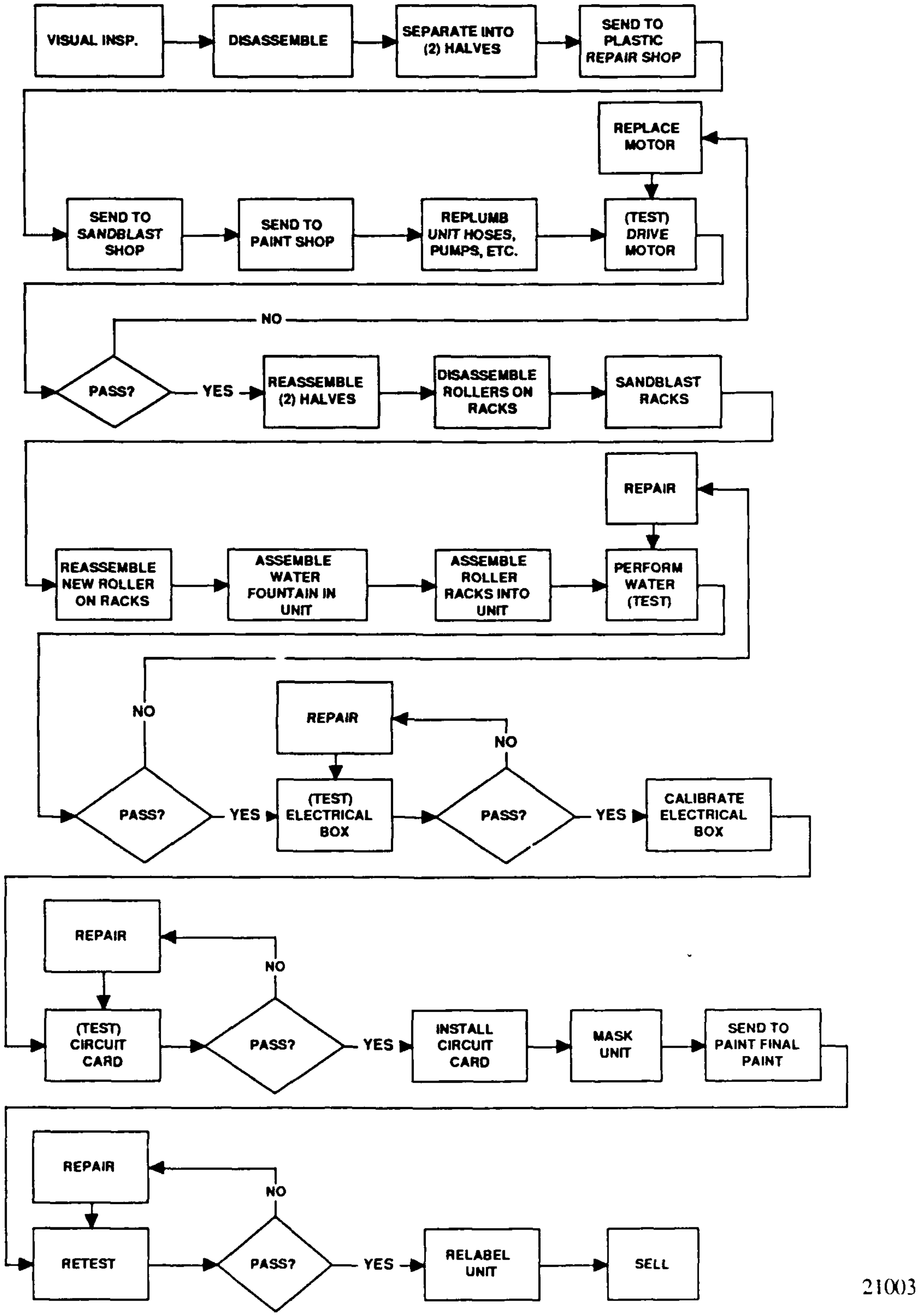
7.1.1.2 Description of Current Process Problems

The fact that an end item can be introduced into the RCCs with such a lack of forethought is an indication that no one is accountable for the following:

- Ensuring that the repair process has been well planned to provide top quality repairs the first time
- Ensuring that the introduction of the new end item will not adversely affect the ability of the RCC to perform its other responsibilities
- Ensuring that technicians are fully trained to perform repairs upon receipt of the new end items

The fact that an end item can be processed through the RCC for a year and a half with such a lack of documentation is an indication that no one is accountable for:

- The cost of processing the end item
- Reducing the cost of processing the end item
- The quality of repairs performed
- Improving the quality of repairs

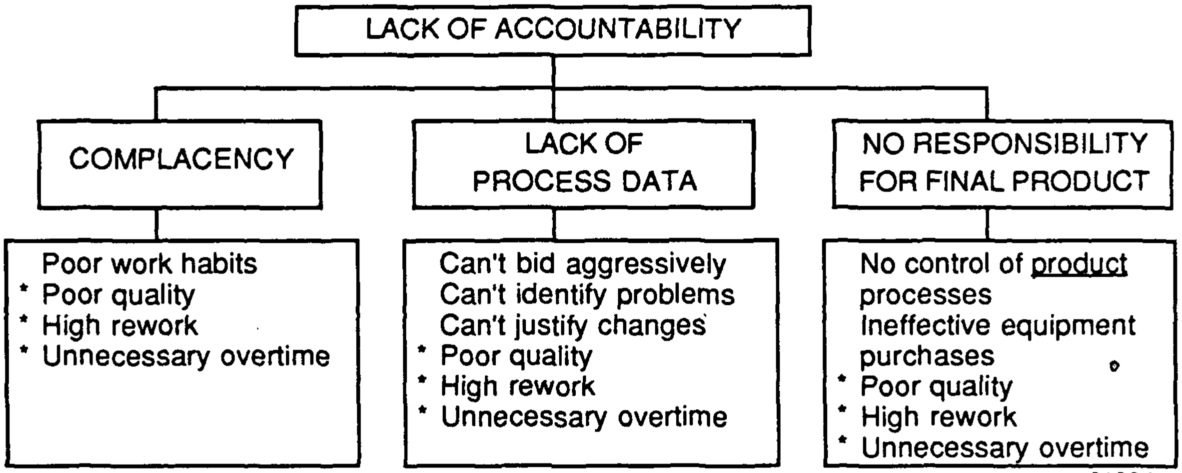


FLOW CHART FOR ACTUAL REPAIR PROCESS FOR ROYAL PRINT PROCESSOR

FIGURE 7.1.1.1-1

- Monitoring performance of the repaired end items in the field
- Monitoring customer feedback

See Figure 7.1.1.2-1 for a summary of current problems.



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LACK OF ACCOUNTABILITY FLOW CHART
FIGURE 7.1.1.2-1

7.1.1.3 Description of New Process

The new process consists of assigning defined responsibilities to individuals and providing a means of monitoring their performance. The tool for collecting performance data is a modified WCD which is detailed in Paragraph 7.1.2.

Below is a list of responsibilities for RCC personnel.

Technicians:

- Fill out WCDs completely, accurately, consistently, and on time
- Transport items to next operation (OP) station or subunit supervisor to ensure smooth continuation of repair process
- Meet time standards for operations assigned
- Be active in developing process improvements
- Use Statistical Process Control (SPC) techniques

RCC Foreman:

- Fill out WCDs accurately, consistently, and on time (as required)
- Ensure that end items brought into the work area are delivered to the appropriate technician so work can start in a timely fashion
- Be available at all times to solve work flow problems. If the supervisor can't be available, an acting supervisor must be appointed
- Ensure that end items leaving the area are delivered in a timely manner to their destination (scheduling, another subunit, etc.)
- Review WCD data prior to reviewing technicians to ensure that they are meeting or exceeding standards
- Keep Scheduling advised of the subunit's workload status to assist schedulers in providing a steady flow of work
- Help newly appointed process engineers develop an understanding of the repair processes of the Part Control Numbers (PCNs) for which they are responsible.

Process Engineer:

- Collect all pertinent information for PCNs assigned to the area
  - Documentation (Technical Orders (TOs), technical bulletins, drawings, WCDs)
  - Shop information (where the items are repaired, who repairs them, and how they repair them)
- Ensure that all documentation is correct and current and make changes as required
- Ensure that each operation has a specific step-by-step procedure so that repairs can be standardized
- Review all WCD data monthly to identify problem areas and implement solutions
  - Large flow/process times
  - Rework
- Ensure that all support groups do, in fact, support the PCN processes, particularly parts supply
- Ensure that end items meet quality standards and schedule without overtime

- Ensure that end items reflect improved process control
  - Higher quality
  - Less rework
  - Reduced costs
  - Reduced flow time
- Provide engineered time standards
- Initiate and control new equipment purchases
- Perform quality audits

Unit Chief:

- Provide maximum support for process engineers
- Collate and review quarterly process data for PCNs provided by process engineering
- Use process data to negotiate for a larger workload
- Use process data to secure funding for new equipment
- Use process data to evaluate proposed process improvement
- Set management annual cost reduction and quality goals, and develop plans to achieve them.

To increase the chances for successful implementation of this plan, the issue of technicians' attitudes must be addressed. Appendix F of this report discusses a methodology that can be used to improve the attitudes of the technicians.

7.1.1.4 Rationale for Change

Cannibalization of end items, Work In Process (WIP) items sitting in the RCC for months, and idle technicians are all indications of a process out of control. One of the major causes of this is the lack of accountability for the overall flow of individual end items. Paragraph 7.1.1.3 discussed how this lack of accountability can be remedied, with emphasis being placed on the creation of an organization behavior modification (OB Mod) program. If the recommendations are implemented with management support and involvement, the RCC will soon have people who are extremely familiar with the end items produced by the RCC and who have a desire for continuous process improvement. As a result of developing this familiarity with the end item, process problems should be identified and solved, thus resulting in reduced flow times and better quality.

7.1.1.5 Estimated Cost Savings

The Fuel Control Repair Unit (FCU), located at San Antonio Air Logistics Center (SA-ALC), is similar to MAKPRA in that most of the repairs involve intense bench work with a final acceptance test. SA-ALC established a data tracking system for the FCU. Based on data provided by SA-ALC it is estimated that a 35% reduction in process times (touch labor) can be realized by establishing a similar accountability program. The annual savings for MAKPRA will be as follows:

$$63 \text{ employees} \times \frac{1840 \text{ hr}}{\text{employee}} \times \frac{\$43.50}{\text{hr}} \times .35 \text{ savings} = \$1{,}764{,}882$$

7.1.1.6 Implementation Cost/Schedule

The cost of implementation for these three quick fixes (7.1.1 through 7.1.3) will be more than offset by the savings. These quick fixes will not interfere with production because employee time is available to accomplish these quick fixes (CSR Paragraph 7.1.6). The dedicated technician assigned to these three quick fixes (7.1.1 through 7.1.3) will be selected from the available overhead people.

The implementation of these three quick fixes can begin as soon as a technician is assigned. The technician will need approximately one month for preparation. One month after this preparation period, classroom training can begin. It is recommended that the classes be limited to six people, with no more than three classes a week being scheduled. This will allow the technician to be available to monitor the progress of the quick fixes in the RCCs. Presently there are 143 people (including one dedicated technician) assigned to the RCC. The shop hourly rate is $43.50.

Average annual cost of a dedicated technician:

$$\frac{1840 \text{ hr}}{\text{employee}} \times \frac{\$43.50}{\text{hr}} = \$80{,}040$$

Cost of class room training:

$$4 \text{ hrs} \times 142 \text{ employees} \times \frac{\$43.50}{\text{employee-hr}} = \$24{,}708$$

Total Cost = $104,748

7.1.1.7 Risk Assessment

The greatest risk lies in maintaining the status quo. The current situation is highly inefficient, a state of affairs that should not be tolerated if the future of the RCC is to be secure in an era of budget cuts and manpower reductions.

7.1.2 Improved Process Control Data Collection

7.1.2.1 Description of Current Process

There currently is no method for collecting viable repair process information on a daily basis.

7.1.2.2 Description of Current Process Problems

The lack of accurate, current information about the repair processes leads to two major problems.

The first problem occurs when the RCC has to negotiate for workload. The workload, which is the life blood of the RCC, is negotiated based on input from erroneous time standards. The future of the RCC is being staked on information known to be inaccurate and educated guesses from the same people who provided much of the original inaccurate information.

The second problem occurs when attempts are made to justify potential process improvements. Not only is the baseline information either inaccurate or unavailable, but there is also no system in place to collect that information. This same problem makes it impossible to show how a process improvement will affect total process flow, thus making justification difficult, if not impossible.

7.1.2.3 Description of New Process

The new process involves modifying the WCD per Appendix B, and then having the appropriate personnel supply the requested time information on the WCD. This information will then be collated by process engineers who will evaluate it for use in making process improvements. The modification in the WCDs will also require rewriting existing job descriptions to reflect the new responsibilities of all employees. Very close attention should then be paid at review time to how well the technician has complied with the requirements for completing the new WCDs. In the case of upper

level employees, the review should also consider how well they have used the data available on the WCD. The responsibilities that need to be assigned to each group were detailed in Paragraph 7.1.1.3.

The process to be used with the modified WCDs is illustrated in Figure 7.1.2.3-1. Appendix C is an example of what the Royal Print Processor WCD (Reference Paragraph 7.1.1.1) should look like, minus the proper TO call-outs, which should be provided by the cognizant process engineer before the document is released to the shop. Appendix D shows how this WCD would be stamped by RCC personnel.

7.1.2.4 Rationale for Change

In order to have process control, it is necessary to know what is happening, when it happens, and how often it happens. Analysis of the data provided by the revised WCD will answer what, when, and how often, while highlighting the areas that most need improvement.

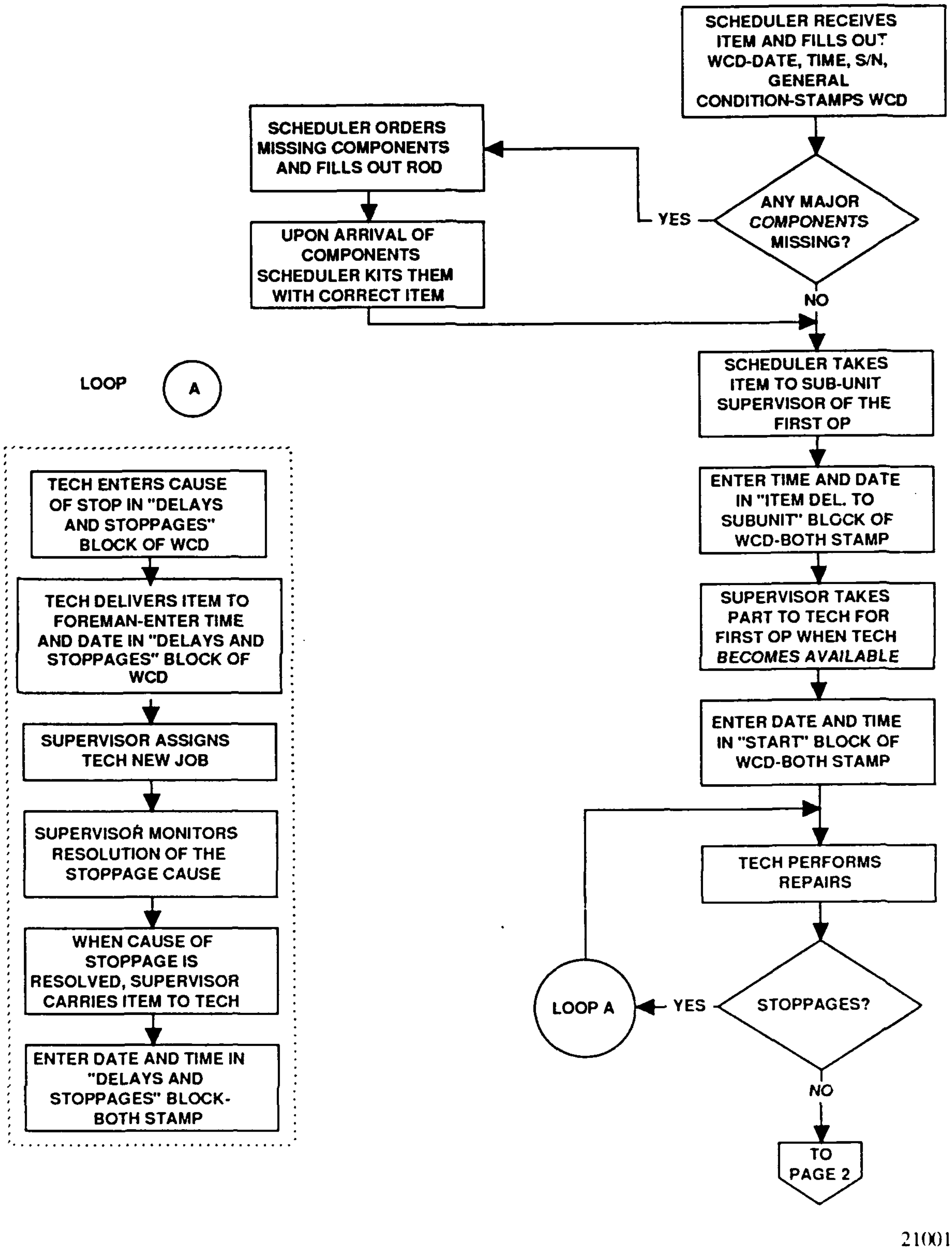
7.1.2.5 Estimated Cost Savings

To stay in existence in a time of budget cuts and proposed manpower reductions, it is vital to pursue continuous process improvement. The first step in achieving this goal is to gain control of the existing repair processes. From there, it will be possible to identify those areas most in need of improvement. Once the problems are identified, potential solutions can be proposed and their impact on the overall process can be assessed. Good estimates of potential savings can be developed for those solutions that show promise.

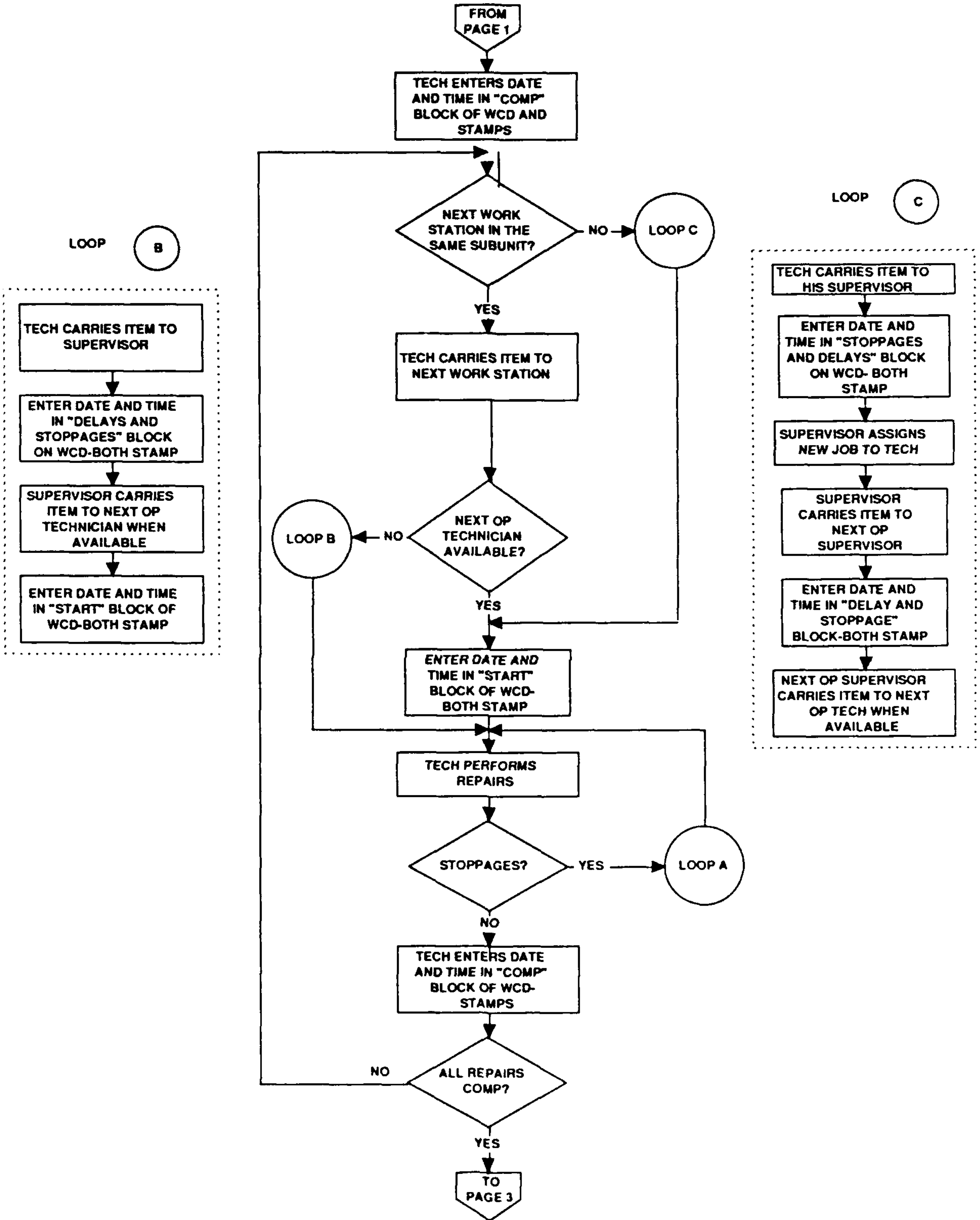
Gaining total process control will also permit the RCC to negotiate aggressively for a larger workload since the negotiating team will have hard data to work with instead of misleading time standards and educated guesses.

7.1.2.6 Implementation Cost/Schedule

Refer to Paragraph 7.1.1.6.



MODIFIED WCD FLOW CHART
FIGURE 7.1.2.3-1 (SHEET 1 OF 4)



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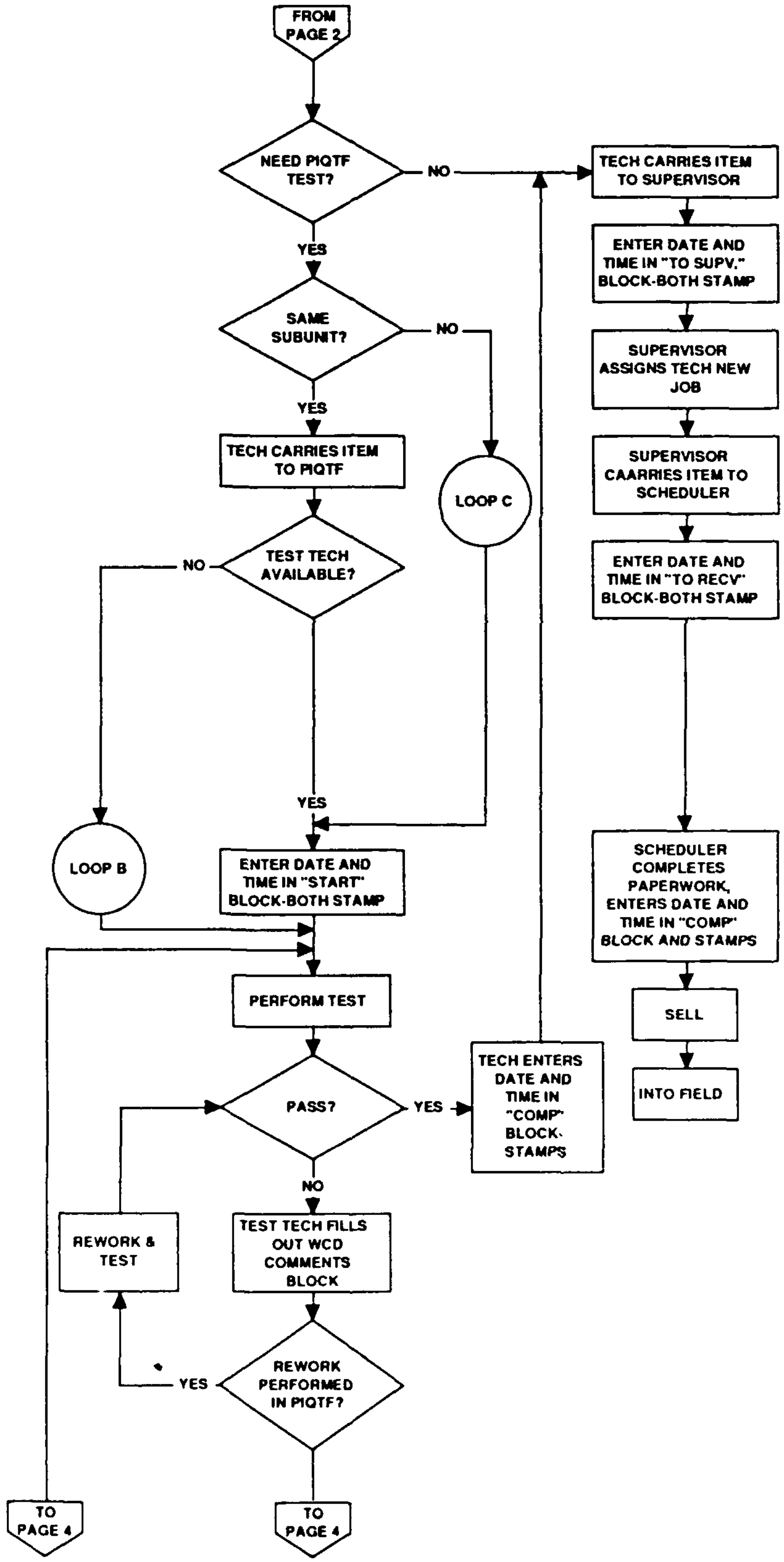
MODIFIED WCD FLOW CHART
FIGURE 7.1.2.3-1 (SHEET 2 OF 4)



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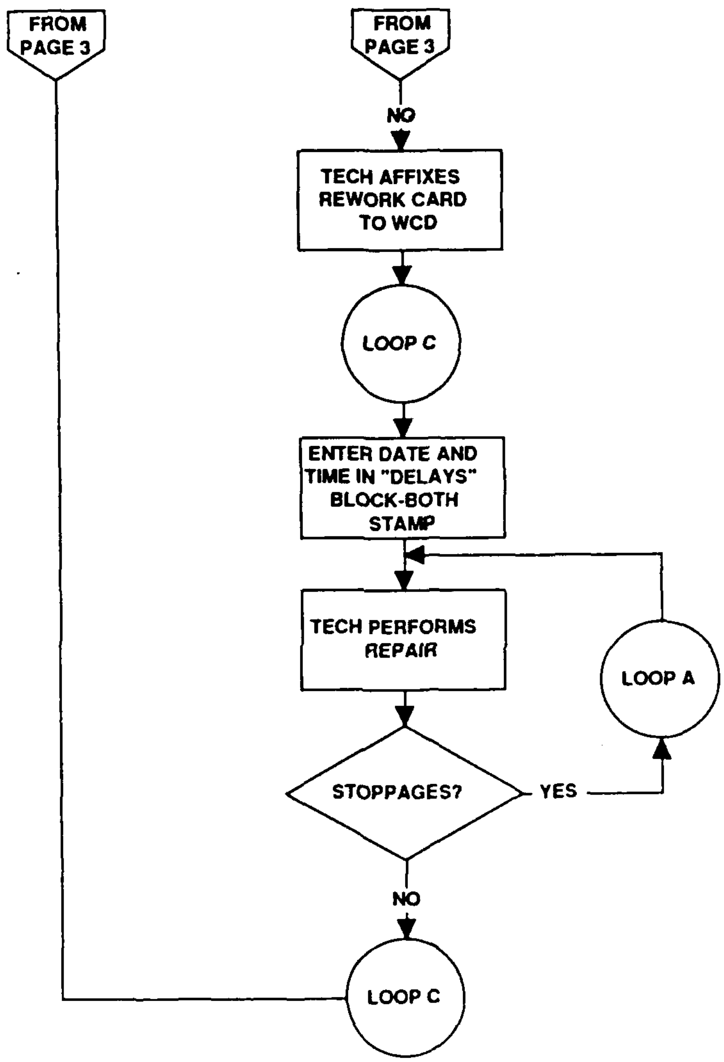
MODIFIED WCD FLOW CHART
FIGURE 7.1.2.3-1 (SHEET 3 OF 4)



21001

MODIFIED WCD FLOW CHART
FIGURE 7.1.2.3-1 (SHEET 4 OF 4)

7.1.2.7 Risk Assessment

The RCC cannot afford to ignore this quick fix. The ability to monitor the processes is the key to any improvements. Maintaining the status quo is an invitation to furloughs and reduced or eliminated workload.

7.1.3 Modify Work Plans

7.1.3.1 Description of Current Process

Examples of the existing work plans for technicians, wage grade 10 and 11, are displayed in Appendix E.

7.1.3.2 Description of Current Process Problems

Existing work plans make no provisions for specifying employee performance with regard to quality or process improvement.

7.1.3.3 Description of New Process

Work plans should be modified to include the responsibilities listed in Paragraph 7.1.1.3. Performance reviews must consider how well the employee complied with these new responsibilities.

7.1.3.4 Rationale for Change

Employees need to know that they will be held accountable for their performance with regard to data collection and process improvement responsibilities.

7.1.3.5 Estimated Cost Savings

Savings will be realized due to the reduction of unit costs incurred by enforcing the RCC mandated goal of a 10% improvement in process time per employee.

7.1.3.6 Implementation Cost/Schedule

Refer to Paragraph 7.1.1.6.

7.1.3.7 Risk Assessment

There are no risks.

7.1.4 Improved Control of Capital Equipment Purchasing and Utilization

7.1.4.1 Description of Current Process

In the past, control of capital equipment purchases passed very quickly out of the hands of the people for whom the purchase was being made. Final decisions about the purchase were made by people miles away geographically and even more distant in their perception of the needs of the RCC. Integrated Organizational Development (IOD) does not appear to have substantially improved this arrangement. Purchases still need to be made through another division (LIMT).

7.1.4.2 Description of Current Process Problem

The problem is that large sums of money are spent on equipment that goes unused or is under-utilized once it gets to the shop floor. There are two pieces of equipment in the RCC that demonstrate this problem quite clearly.

The first is a sandblaster (approximately $3,300) that was purchased for use on processor frames. Universal Depot Overhaul Simulator, Version 2.0 (UDOS 2.0) simulation model demonstrated that the sandblaster, if installed, would not reduce the flow time of the end items affected. The present method of sending these end items to a back shop for sandblasting is sufficient given the current workload (Contract Summary Report [CSR] Paragraph 7.2.1.3).

The second example of the problem is the new diamond lathe ($501,375) in the lens repair area. This was a very expensive piece of machinery, both to purchase and to install. It sits unused because ten feet away from it is a similar machine that handles the RCC's workload (CSR Paragraph 7.1.5).

7.1.4.3 Description of New Process

Process specifications for new equipment should be written by the cognizant process engineer/engineers in conjunction with the production people who will use the equipment and their supervisor. Below is the new equipment purchasing plan.

TASK ORDER NO. 18
PROCESS CHARACTERIZATION

<u>PRIOR</u> to purchasing the equipment, a Process Action Team (PAT) must be formed consisting of the following people:

1. All process engineers who have end items or subassemblies that need to pass through the process

2. The supervisor of the subunit that will receive the new equipment

3. At least one of the technicians who will operate the new equipment

4. A representative from each of the departments that will have to install and maintain the new equipment

Issues that will be addressed by the above people are:

1. Need for new equipment

2. Specifications/requirements

3. Utility hook-up

4. Maintainability

5. Installation

6. Training

7. Delivery/process flow interruption

After addressing these issues a manufacturing and model/type should be selected by tne process engineer. This information should then be provided to purchasing. Purchasing will solicit bids as required. Before issuing a purchase order, purchasing must provide the process engineer with all pertinent information on the winning manufacturer's equipment. The engineer must provide this information to the PAT team for their review. Sign-off is required by all members of the PAT team including

the process engineer. At this time authority should be given to purchasing to place the order. Paragraph 7.1.5.7 provides an example of how the process should work.

7.1.4.4 Rationale for Change

The current system is cumbersome and does not effectively serve the needs of the RCC. It causes an unnecessary expenditure of funds both in direct capital spending and in extra costs because of lack of support after a new piece of equipment is delivered.

Implementation of this quick fix puts the responsibility for new equipment specifications and support into the hands of the people who will be most directly affected by the introduction of that new equipment into the RCC.

The IPI engineers would like to see the RCC develop the same philosophy toward equipment purchases that Steelcase Corporation has (as related on pages 82-83 of the book The Renewal Factor). At Steelcase, an equipment purchase is not approved until the person designated to run the equipment has reviewed the machine design, and also had an opportunity to suggest engineering changes. By involving the RCC technicians in equipment purchases, the technicians are likely to develop more pride in their jobs and a heightened sense of responsibility.

The RCC should do a better job of soliciting feedback from their technicians. The technicians, as a group, do not think that they are consulted enough on subjects which affect the jobs that they do. The technicians' true value to the RCC is not close to being realized, and a good first step would be to get the technicians involved in equipment acquisition decisions.

7.1.4.5 Estimated Cost Savings

Savings are difficult to assess because in most cases, the new system will eliminate the potential for wasted capital before it occurs. An example of money that could have been saved is the purchase cost of the diamond lathe machine, which amounted to $501,375, and the $3,300 cost of the sandblaster.

7.1.4.6 Implementation Cost/Schedule

The only cost involved, training, is as follows:

$$143 \text{ people} \times .5 \text{ hrs} \times \frac{\$43.50}{hr} = \$3{,}110$$

7.1.4.7 Risk Assessment

The current system is costing Ogden Air Logistics Center (OO-ALC) money through the purchase of superfluous equipment. The new system costs little to implement, gives decision-making responsibilities to the people with the most knowledge of the problem, and still leaves actual issuing of purchase orders in the hands of the purchasing department. The risks involved are negligible.

7.1.5 Improved Process for Circuit Card Stripping

7.1.5.1 Description of Current Process

The current operation involves dipping the circuit card into a chemical solution for 15 minutes to one hour. The card is then neutralized and washed with deionized water. Remnants of the sealing coat and other contamination are removed by hand.

7.1.5.2 Description of Current Process Problems

The current process is time consuming, tedious, and produces hazardous waste.

7.1.5.3 Description of New Process

The proposed solution calls for using a plasma etching chamber. Inside this partial vacuum chamber, ionized gases are used to bombard the sealing coat. Through the process of ablation, the coating is removed and the resulting waste is suctioned out of the chamber by the vacuum pump. The vendor contacted by MDMSC was:

Beta^2, Inc.
15 Secor Rd.
P.O. Box 5226
Brookfield, CT 06084

PRIOR to purchasing the equipment, a PAT must be formed consisting of the following people:

1. All process engineers who have end items or subassemblies that need to pass through the stripping process

2. The supervisor of the subunit that will receive the plasma etcher

3. At least one of the technicians who performs the current stripping process

4. A representative from each of the departments that will have to install and maintain the unit

Issues that will be addressed by the above people are:

1. Quantity of boards processed per batch

2. Fixturing of boards/size of boards

3. Composition of boards

4. Location and facility requirements of new machine

5. Maintenance of new machine

6. *Training for engineers and* technicians

7.1.5.4 Rationale for Change

The proposed process is relatively simple, environmentally safe, and will be less labor intensive and time consuming.

7.1.5.5 Estimated Cost Savings

After investigating the hazardous waste discharge associated with the current method of stripping circuit cards versus the proposed method, the IPI engineers determined that the actual dollar savings are very low in comparison with the investment cost.

However, conversations with an environmental engineer (EMR) revealed that the Air Force has a proposed zero discharge pollution prevention program starting in 1992. The mandate is to obtain zero hazardous waste discharge from Hill AFB. Implementation of this recommendation will help the RCCs accomplish this goal by reducing the amounts of zylene and epoxy wastes produced. For this reason, the proposed process change, while not cost justified, is an important step in obtaining the zero hazardous waste reduction goal.

7.1.5.6 Implementation Cost/Schedule

The cost of a typical plasma etching system is $10,000. Lead time for acquiring the unit is approximately two months from confirmation of the order. Start-up and training should be two weeks. Training cost:

$$2 \text{ employees} \times \frac{80 \text{ hrs}}{\text{employee}} \times \frac{\$43.50}{\text{hr}} = \$6,960$$

Total cost = $16,960

7.1.5.7 Risk Assessment

If the PAT team members address the above issues thoroughly, the risks involved in using a plasma etch process will be small. The technology is mature and if the PAT team members can provide process parametric information, the equipment manufacturer's applications department should be able to match a machine to the needs of the RCC.

7.1.6 <u>Improved Controls for Adjusting PIQTF Collimator Table Height</u>

7.1.6.1 Description of Current Process

To raise and lower the table, the technician must kneel on the floor to reach the start/stop button. The height of the table is then measured using a tape measure.

7.1.6.2 Description of Current Process Problems

Kneeling on the floor is awkward and uncomfortable. Reading the tape measure is difficult because it is hard for the technician to see the scale and be accurate.

7.1.6.3 Description of New Process

Control buttons should be placed where the technician can easily reach them. The tape measure should be replaced with a standard wire activated 10-turn potentiometer. This requires mounting a digital readout and a 5-volt power supply on the table top (See Figure 7.1.6.3-1).

7.1.6.4 Rationale For Change

The quick fix is inexpensive to implement and will reduce operator discomfort. It also will make height readings more accurate and repeatable, thus improving process control.

7.1.6.5 Estimated Cost Savings

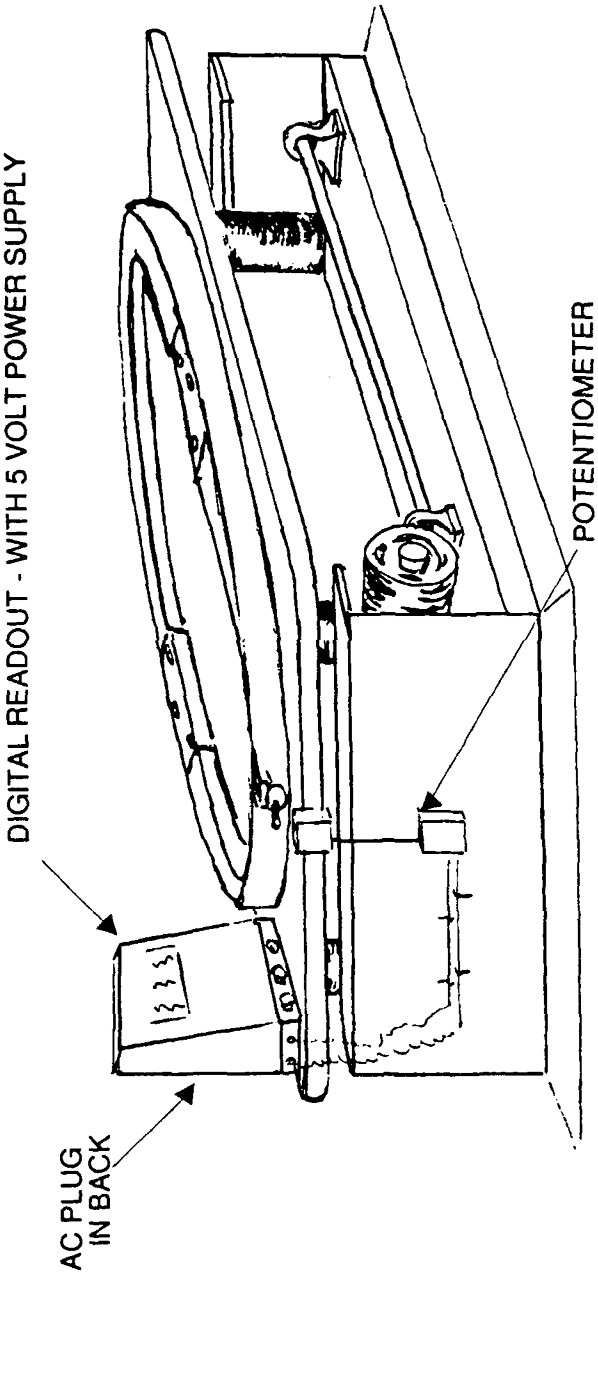
A discussion with the technician in the PIQTF area revealed that implementation of this idea would reduce the set-up time per end item by two minutes. To estimate the quantity of items processed using the table, five random five-day periods were selected from the logbook. The information collected is summarized below, with 1989 being selected as the base year.

Week Beginning	No. of Items process Using PIQTF Collimator Table
Feb 3	33
April 3	12
July 21	13
Aug 21	21
Nov 13	30

Averaging this data gives a weekly production of 21.8 items, which converts into an annual production of 1134 items. Two minutes per item will be saved by modifying the table. The annual savings that will result is:

$$\frac{2 \text{ minutes}}{\text{item}} \times \frac{1 \text{ hr}}{60 \text{ mins}} \times \frac{\$43.50}{\text{hr}} \times \frac{1134 \text{ items}}{\text{yr}} = \$1,644$$

The primary benefit of the table modification is improved table positioning, which will lead to better control of process repeatability.



MODIFICATIONS TO COLLIMATOR TABLE
FIGURE 7.1.6.3-1

7.1.6.6 *Implementation Cost/Schedule*

Instruments needed to implement this idea have an estimated cost of less than $1,000. Once the instruments have arrived, installation can begin when the workload permits and should take no more that a day. Cost breakdown is as follows:

Item	Cost
Power Supply	$150
Digital Readout	$200
Potentiometer	$30
Labor (two people at eight hours at $43.50/hr)	$348
Total	$728

(cost information - McMaster-Carr catalog)

7.1.6.7 Risk Assessment

There is no risk associated with this idea.

7.1.7 Improved Data Collection by Recording Information from Life Cycle Counters

7.1.7.1 Description of Current Process

The RCC sends repaired items to the field without resetting life cycle counters to zero.

7.1.7.2 Description of Current Process Problems

Repaired end items are sent to the field with no system in place to record mean time between failures (MTBF). This means that items with recurring problems go undetected and are not subject to an engineering review.

7.1.7.3 Description of New Process

On items with life cycle counters, set the counters to zero upon completion of the repair. When the end item comes back to the RCC, the life cycle counter readings should be recorded on the WCD for review by the process engineer. Data from items with counters that cannot be reset should be compared against the reading recorded on the WCD when the item was last in for repair.

7.1.7.4 Rationale For Change

No procedure is currently in place to identify end items that consistently have an unnaturally short MTBF, which makes it impossible to tell whether the RCC is producing quality end items. This quick fix will provide a mechanism to capture this information.

7.1.7.5 Estimated Cost Savings

Savings will occur because recurring problems will be identifiable, thus allowing them to be resolved. This will halt the cycle of shipping the offending end item back into the field, only to have it fail again and be returned to the RCC. The lack of data makes it impossible to quantify this idea. Hopefully this data will enable process improvements to be identified that will substantially improve end item quality.

7.1.7.6 Implementation Cost/Schedule

It is only necessary to instruct the technicians to reset the counters when the repair is completed and record the data at induction. The idea can be implemented immediately. There is no cost.

7.1.7.7 Risk Assessment

There are no risks.

7.1.8 Improved Safety by Installation of a Water Hookup for Processor Repair Area

7.1.8.1 Definition of Current Process

To get water needed to perform film tests, technicians use faucets in the rest rooms to fill buckets, then carry the water to the work area where it is needed.

7.1.8.2 Description of Current Process Problems

The current method is time-consuming and aggravating for the technicians. There is also the potential for workers to injure themselves by slipping in water spilled from the buckets or by hurting their backs carrying heavy buckets.

7.1.8.3 Description of New Process

Provide hot and cold water outlets and a drain in the immediate work area.

7.1.8.4 Rationale for Change

The major concern is the safety issue. Accidents due to the wet floor could result in lost time.

7.1.8.5 Estimated Cost Savings

Data collected during assessment of the printer repair area indicates that two hours per end item could be saved by installing hot/cold water outlets and a drain. The area repairs approximately 45 units per year. Using this information, the annual savings that would result from the proposed facility change would be:

$$\frac{2\text{ hrs}}{\text{item}} \times \frac{45\text{ items}}{\text{yr}} \times \frac{\$43.50}{\text{hr}} = \$3{,}915$$

The recommendation is more important from a safety aspect because it would eliminate the potential hazard of a technician slipping on spilled water.

7.1.8.6 Implementation Cost/Schedule

Estimated labor cost:	$2\text{ people} \times \frac{8\text{ hrs}}{\text{person}} \times \frac{\$43.50}{\text{hr}} =$	\$696
Material cost:		<u>\$300</u>
Total:		\$996

The time to implement this idea will range from a few days to a week depending on how well the different departments interface with the RCC.

7.1.8.7 Risk Assessment

There are no risks.

7.1.9 <u>Improved Safety Through the Use of Fixtures for the Processor Frames</u>

7.1.9.1 Description of Current Process

Currently, the large processor frames are moved manually on tables when repair work and testing are performed. There are several instances where the heavy items must be turned over.

7.1.9.2 Description of Current Process Problems

Processor frames are heavy (over 100 pounds) and awkward to move.

7.1.9.3 Description of New Process

The subunit has had a request in for mobile/rotating holding fixtures for approximately two years. This request should be followed up and the fixturing should be built.

7.1.9.4 Rationale for Change

The fixtures should be built before someone is hurt moving the end item.

7.1.9.5 Estimated Cost Savings

This quick fix addresses a safety issue. It is designed to keep people from getting hurt and incurring expensive medical bills. Presently, it takes three people to rotate the item. The proposed fixtures would require only one person to rotate the end item. It takes .25 hours to rotate the item. This will produce an annual savings of:

$$2 \text{ people} \times \frac{.25 \text{ hr}}{\text{item}} \times \frac{45 \text{ items}}{\text{yr}} \times \frac{\$43.50}{\text{man hr.}} = \$979$$

7.1.9.6 Implementation Cost/Schedule

Costs will be less than $500 per fixture (as estimated by the technician who works the end item) for four fixtures. Construction time should be no more than one month from date of order.

7.1.9.7 Risk Assessment

There are no risks.

7.1.10 <u>Improved Method for Shim Storage</u>

7.1.10.1 Description of Current Process

Shims to fine-tune cameras mounted on the table in the picture imaging quality test facility (PIQTF) area are currently stored loosely in a box.

7.1.10.2 Description of Current Process Problems

It is time-consuming to rummage through the box looking for the necessary shims used to mount the end item to be tested.

7.1.10.3 Description of New Process

Plastic sleeves, similar to the type that hold photographs, should be used to store the shims. The shims should be cataloged and their sleeves stored in a ring binder.

7.1.10.4 Rationale For Change

The current technique causes unnecessary delays. Cost savings will be realized in the form of reduced flow time in the PIQTF area.

7.1.10.5 Estimated Cost Savings

Organization of existing shims will result in an average savings of five minutes in the repair time per end item. As previously calculated in 7.1.6.5, 1134 items per year are processed. Using this information, the annual savings that would result from improved shim storage will be:

$$\frac{5 \text{ mins}}{\text{item}} \times \frac{1 \text{ hr}}{60 \text{ mins.}} \times \frac{\$43.50}{\text{hr}} \times \frac{1134 \text{ items}}{\text{yr}} = \$4{,}110$$

7.1.10.6 Implementation Cost/Schedule

Cost will be less than $20 for two picture album binders. Implementation would only take a few hours.

7.1.10.7 Risk Assessment

There are no risks.

7.1.11 Improved Product Quality Through Environmental Control of the Coating Process

7.1.11.1 Description of Current Process

Precision optics are currently being finished in an uncontrolled environment subject to fluctuations in temperature, humidity and particulate infiltration.

7.1.11.2 Description of Current Process Problems

Dust and moisture settling on surfaces to be coated will result in pinholes in the coating. The holes permit moisture to get between the substrate surface and the coating. This results in a separation between the two layers, increasing the likelihood of premature optical degradation.

7.1.11.3 Description of New Process

Cleaning and coating of lenses and mirrors should be performed in a Class 1000 clean room environment. MDMSC recommends using down-flow Class 1000 portable clean booths around cleaning and coating areas. The suggested location is shown in Figure 7.1.11.3-1. Transportation between controlled areas should be made with the optical component stored in a clean room certified container.

Additional information on clean rooms can be found in TO 00-25-203, Paragraphs 7.0 through 7.4 and from the following vendor:

Airfiltronix
P.O. Box 131
Congers, NY 10920

7.1.11.4 Rationale for Change

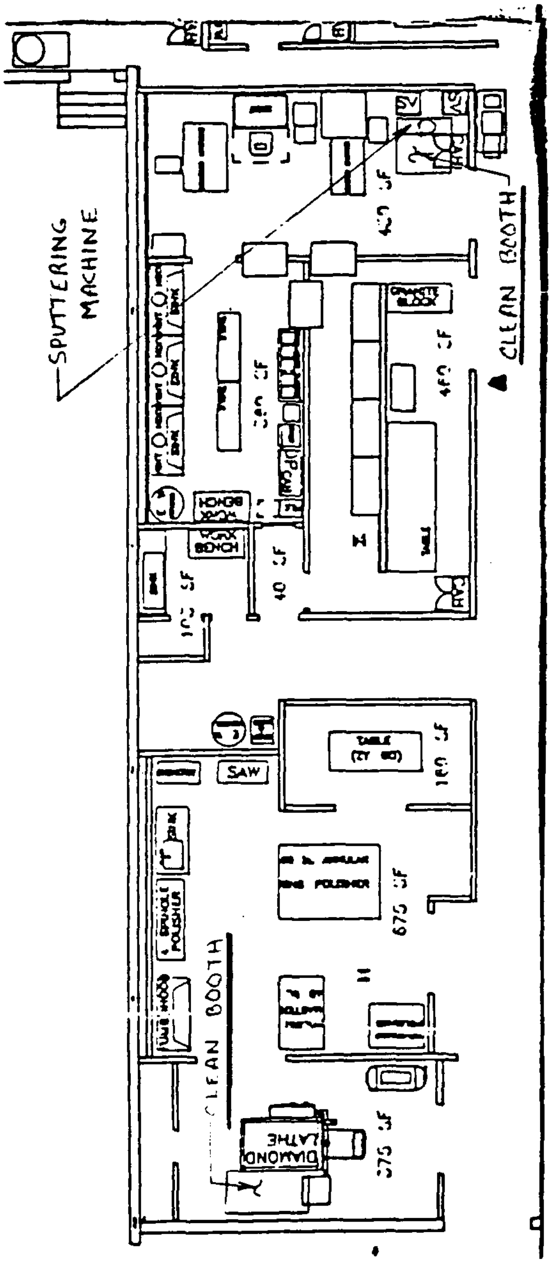
Contaminated optical components will need costly rework or will fail prematurely in the field. Peacetime failures result in minor logistical losses, (i.e. fuel, film, etc.). However, combat failure of optical components can lead to major losses of both material and personnel due to the lack of photo reconnaissance information needed to make effective tactical/strategic command decisions.

7.1.11.5 Estimated Cost Savings

Due to the current lack of rework data, MTBF data, or customer feedback in the RCC, it is impossible to estimate the savings resulting from implementation of this quick fix. However, the RCC owes the customer the best in quality and performance and this idea is geared directly to improving those two criteria.

7.1.11.6 Implementation Cost/Schedule

The cost for a Class 1000 8' x 4' x 4' booth is approximately $5,000. The IPI engineers envision a need for two booths - one for the diamond lathe area and one to surround the machine used to coat mirrors and lenses. The RCC should also invest in several off-the-shelf clean room certified containers made of Delrin or a similar material to



▲ BOOTH SHOULD COMPLETELY ENCLOSE SPUTTERING MACHINE

LAYOUT OF LOCATION OF PROPOSED CLEAN ROOM BOOTHS
FIGURE 7.1.11.3-1

provide a clean environment for transportation between booths. Cost will be less than $100 per container, and no more than two containers should be needed.

Implementation will be determined by the lead time for the booths, which should be approximately three months from the time the order is placed.

7.1.11.7 Risk Assessment

There are no risks involved.

7.1.12 Improved Method for Resurfacing Pressure Platen

7.1.12.1 Description of Current Process

Technicians resurface the platen by hand by rubbing the platen over a piece of sand paper mounted on a flat surface. It is then checked for flatness on the comparator and resanded until it is within the specifications. The platen is then painted and the sand/check/sand procedure is repeated.

7.1.12.2 Description of Current Process Problems

The procedure is redundant and time-consuming.

7.1.12.3 Description of New Process

The new process is as follows:

- Strip the old paint chemically.
- Polish platen on the existing glass polishing wheel and check on comparator.
- Repaint with carbon activated paint or satin finish anodize.

7.1.12.4 Rationale for Change

The current method is tedious and time-consuming. The new method will be faster, require less human manipulation of the end item, and produce a finish that will outlast that provided by the current paint method.

7.1.12.5 Estimated Cost Savings

The proposed method for resurfacing the pressure platen would eliminate the second sanding operation, which shows a simulated process time of four hours according to

the UDOS 2.0 model output. Approximately 176 platens are repaired per year. Using this information, the annual savings that would result from implementation of the new process would be:

$$\frac{4\ \text{hrs}}{\text{item}} \times \frac{176\ \text{items}}{\text{yr}} \times \frac{\$43.50}{\text{hr}} = \$30{,}624$$

7.1.12.6 Implementation Cost/Schedule

As detailed in the notes of the MDMSC Senior Optics Specialist, the current method of resurfacing the platen should be modified in two ways. The first concerns how the paint is removed from the platen. Upon investigation, the IPI engineers found a cream stripper that can be used for paint removal. It is Cream Strip, which is made by Marchyde Co. The stripper, because it would be applied directly to the platen, would be used at a slow rate (estimated usage would only be three gallons per year). At a cost of $24.15 per gallon, the conversion to the new type of stripper would be approximately $73.

The second change involves resurfacing the platen. The existing paint should be replaced with satin finish anodize. MDMSC estimated the cost of the anodize (which is commonly available) to be comparable to the paint currently being used, so no additional costs are expected to result from this change.

7.1.12.7 Risk Assessment

There are no risks.

7.1.13 Improved Safety Through the Use of a CRT Alignment Video System

7.1.13.1 Description of Current Process

A completed cathode ray tube (CRT) unit is placed on a test stand and is then plugged into electronic instrumentation. A microscope is used to line up the 12 trace cross hairs and spot size. The technician looks at the traces with the microscope as he aligns the coils.

7.1.13.2 Description of Current Process Problems

It takes approximately 30 hours to completely align a CRT. During most of this time the technician is staring at high intensity light through the microscope. The light is painful to look at and there is a serious risk of eye damage to the technician.

7.1.13.3 Description of New Process

The microscope should be replaced with a high resolution video camera and monitor. This will eliminate the risk to the technician. Because the new system will eliminate the need to look into a bright light, flow time and process time will be reduced because the technician will need fewer rests from his work. Improved alignment will result because the CRT will be doing the focusing instead of the technician.

7.1.13.4 Rationale for Change

The current system is painful to use and is harmful to the technician's eyes. The technician has to stop periodically in the repair process to rest his/her eyes because of the strain produced from the high intensity light. The new system will reduce flow time and process time because the technician will not be focusing on the high intensity light.

7.1.13.5 Estimated Cost Savings

A reduction of ten to 15 hours per CRT assembly is predicted, depending on the amount of time the technician needs to rest his/her eyes. Approximately 32 assemblies are repaired during a year. Estimating that the use of the camera and monitor would save the technician an average of 12 hours per assembly, the predicted annual savings would be:

$$\frac{12 \text{ hours}}{\text{assembly}} \times \frac{32 \text{ assemblies}}{\text{year}} \times \frac{\$43.50}{\text{hour}} = \$16{,}704$$

7.1.13.6 Implementation Cost/Schedule

Total cost for the new system hardware should not exceed $3,000. The time to install the equipment and acquaint the technician with it should be about a week.

7.1.13.7 Risk Assessment

There are no risks.

7.1.14 Reduce Flow Hours Through Level Inductions

7.1.14.1 Description of Current Process

The repair of items is sometimes delayed because of queuing on resources due to several items "hitting" at the same time. Items often queue up on resources late in the quarter when the RCC is striving to meet its workload demands. The pre-IOD system, with its emphasis on processes rather than products, regularly led to items being inducted by the RCC for repairs in an almost random fashion.

7.1.14.2 Description of Current Process Problems

Items are experiencing unnecessarily long flow times. The observations of the IPI engineers were that numerous items ended up waiting for manpower and equipment because they are inducted in groups. The resources in the RCC are utilized in a "feast or famine" fashion rather than being used in a smooth, consistent manner. The majority of the equipment undergoes periods of idleness followed by periods of high-intensity use. Because of this, equipment breakdowns are more disruptive to the RCC's production.

7.1.14.3 Description of New Process

The RCC, under the empowerment concept which is part of the IOD concept, will have more control over how items get processed through the area. Therefore, the scheduling that has hurt the RCC's operations in the past should be improved upon so that items are brought in on a more regular schedule. Under IOD, the RCC should be able to truly schedule items, rather than simply reacting to a random workload.

7.1.14.4 Rationale For Change

The book The Race, by Eliyahu M. Goldratt and Robert E. Fox, points out the importance of synchronizing the production flow, utilizing what the authors term the "drum-buffer-rope" way. The authors state that items should proceed through a process in an orderly fashion, like a troop marching. The reorganization to the IOD concept allows the RCCs to set their own tempo, rather than just responding to the drumbeat dictated by others.

7.1.14.5 Estimated Cost Savings

The UDOS 2.0 model was used to evaluate the effects of levelling inductions. The results are explained in Paragraph 7.2.4.1. The experiment showed that inducting approximately equal numbers of items each quarter would reduce the average repair time for an item from 10.8 days to 8.8 days. This calculation was made by treating the items as a group. Considering the items individually (where the flow time difference per item was multiplied by the annual inductions and then these numbers were totaled over the entire group), 104,459 flow hours could be saved, which is the equivalent of over 4,352 days.

Focusing on the effect that levelling inductions would have on the annual labor hours needed, a reduction of 710 hours was calculated (refer to Table 8-2 in the Database Documentation Book [DDB]). At a rate of $43.50 per hour, this reduction represents a potential annual savings of:

$$\left(\frac{\$43.50}{hr} \times \frac{12442\ hrs}{yr} \times 1.5\right) + \left(\frac{\$43.50}{hr} \times \frac{710\ hrs}{yr}\right) = \$842{,}726$$

7.1.14.6 Implementation Cost/Schedule

The RCC should strive to start gaining independent control of its internal schedule immediately and gradually work to devise a schedule that covers its entire workload. The RCC must realize that this recommendation is not an "all or nothing" idea, but instead can be implemented in phases, each of which will help the RCC improve its performance.

The implementation of this idea will not require any additional manpower or other resources beyond what is already available to the RCC.

7.1.14.7 Risk Assessment

The IPI engineers do not see any risks associated with this idea.

APPENDIX A

EXISTING WCD FOR ROYAL PRINT PROCESSOR

280244 **WORK CONTROL DOCUMENT (MEDS)** 89235 PAGE 1 OF __ PAGES

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC RCC	5 DATE SCHED	6 DATE COMPLETED
28024A		MKPRAG		

7 P NUMBER	8 TECH DATA	9 ITEM SERIAL NO
	COMMERCIAL MAN.	

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
	6740010420671	

13 SERIAL NUMBER	14 NOUN
	PROCESSOR ROYAL PRINT

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20 Q
		----------CAUTION---------- PERSONNEL WORKING THIS ITEM MUST HAVE BEEN TRAINED IN AND FAMILIARIZ WITH PERTINENT SAFETY PRACTICES			
		AND HAZARDS CONTAINED IN BASIC TECHNICAL ORDERS REFERENCED IN BLOCK 8 AND SUPLEMENTAL T.O 'S THERETO. OBSERVE T.O. CAUTIONS			
		WARNINGS AND PAC REQUIREMENTS.			
	010	----CAUTION---- TOXIC AND/OR FLAMMABLE SOLVENTS IN USE. USE IN ACCORDANCE WITH T.O.			
	020	DISASSEMBLY	M		
	030	CLEANING	M		
	040	SOLDERING	M		
	050	COMPONENTS	M		
	060	WIRING	M		
	070	ASSEMBLY	M		

21 FINAL DESTINATION		22 COORDINATION INITIATING RCC SIGNATURE DATE		23 DOCUMENT SN
DISPATCH	FUNCTIONAL CODE	A	C	28024A
		B	D	

250244 WORK CONTROL DOCUMENT (MEDS) 89235 PAGE 2 OF 2 PAGES

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC RCC	5 DATE SCHED	6 DATE COMPLETED

7 NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL

13 SERIAL NUMBER	14 NOUN
	PROCESSOR ROYAL PRINT

15 DISPATCH STATION	16 PERF RCC OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19	20
	080	ALIGNMENT (WHEN APPLICABLE IAW T.O.)	M		
	090	IN PROCESS VISUAL INSPECTION	M		
	100	FINAL FUNCTIONAL TEST	M		
	110	FINAL VISUAL INSPECTION	M		

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT SN
DISPATCH	FUNCTIONAL CODE	A	C	250244
		B	D	

SFLC FORM 958 NOV 80

APPENDIX B

PROPOSED WCD FORMAT

WORK CONTROL DOCUMENT (MEDS)

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL DESIGN SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	**14 NOUN**	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20 Q
		DESCRIPTION OF INCOMING CONDITION			
			ITEM REC'D	ITEM DELIVERED TO SUBUNIT	
	10	RECEIVE			
		DELAYS & STOPPAGES:			
		COMMENTS:	ARRV	START	COMP
	20	FIRST OP			
		DELAYS & STOPPAGES:			
		COMMENTS:			
	30	SECOND OP			
		DELAYS & STOPPAGES			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT'SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

WORK CONTROL DOCUMENT (MEDS)

PAGE __ OF __ PAGES

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20 Q
		COMMENTS			
			TO SUPV	TO REC	
	40	SELL			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

APPENDIX C

REVISED WCD FOR ROYAL PRINT PROCESSOR

DFS0591 04:55:07 TERMINAL ...
DFS0591 05:... TERMINAL STARTED
DFS0591 ... SHUTDOWN
DFS0591 05:28:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

PAGE 1 OF 10 PAGES

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED
28024		PRAG		

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO
	KODAK COMMECIAL MANUAL TG-2029 06-2029	

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
	6740010420871	

13 SERIAL NUMBER	14 NOUN
XXXXXXXXX	PROCESSOR

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
		CAUTION			
		DESCRIPTION OF INCOMING CONDITION:			
			ITEM REC'D	ITEM DELIVERED TO SUBUNIT	
	10	RECEIVE			
		DELAYS:			
		COMMENTS	ARRV	START	COMP
		CAUTION			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS059I 04:55:07 TERMINAL STARTED
DFS059I 05:29:01 TERMINAL STARTED
DFS... TIME SHUTDOWN
DFS059I 05:23:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
	20	VISUAL INSP			
		DELAYS:			
		COMMENTS:			
	30	DISASSY			
		DELAYS:			
		COMMENTS:			
	40	SEPERATE INTO HALVES			
		DELAYS:			
		COMMENTS:			
MAK RCD	50	PLASTIC REPAIR - TOP HALF			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS059I 04:55:07 TERMINAL STARTED
DFS059I 05:... TERMINAL STARTED
DFS... IMS SHUTDOWN
DFS059I 05:23:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
		DELAYS:			
		COMMENTS:			
MAK PCD	60	SANDBLAST BOTH HALVES			
		DELAYS			
		COMMENTS:			
MAK PN	70	PAINT BOTH HALVES			
		DELAYS:			
		COMMENTS:			
	80	REPLUMB UNIT			
		DELAYS:			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS059I 04:55:07 TERMINAL STARTED
DFS059I 05:29:01 TERMINAL STARTED
DFS981 *IMS SHUTDOWN*
DFS059I 05:25:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
		COMMENTS:			
	90	TEST DRIVE MOTOR			
		DELAYS:			
		COMMENTS:			
	100	REPLACE DRIVE MOTOR			
		DELAYS:			
		COMMENTS:			
	110	ASSY HALVES			
		DELAYS:			
		COMMENTS:			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS0591 05 [illegible]
DFS0591 [illegible]
DFS0591 05:25:27 TERMINAL STARTED

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
	120	DISASSY ROLLER/RACKS			
		DELAYS:			
		COMMENTS			
	130	SANDBLAST RACKS			
		DELAYS			
		COMMENTS:			
	140	ASSY NEW ROLLERS ON RACKS			
		DELAYS:			
		COMMENTS			
	150	ASSY & INSTALL WATER FOUNTHIN			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS0591 05 WORK CONTROL DOCUMENT

DFS0591 05:23:27 TERMINAL STARTED

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
		DELAYS:			
		COMMENTS:			
	160	INSTALL ROLLER RACK ASSY			
		DELAYS:			
		COMMENTS:			
	170	WATER TEST			
		DELAYS			
		COMMENTS			
	180	REPAIR			
		DELAYS			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

US GOVERNMENT PRINTING OFFICE 1980 - 748 180/20204

DFS0591 05:29:21 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

PAGE 1 OF 1 PAGES

DFS0591 05:28:27 TERMINAL STARTED

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
		COMMENTS			
	190	TEST ELECTRICAL BOX			
		DELAYS:			
		COMMENTS:			
	200	REPAIR ELECTRICAL BOX			
		DELAYS:			
		COMMENTS:			
	210	CALIBRATE ELECTRICAL BOX			
		DELAYS:			
		COMMENTS:			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

US GOVERNMENT PRINTING OFFICE 1990 - 748 180/20204

DFS0591 05:27:01 TERMINAL STARTED
DFS081 TIMS SHUTDOWN
DFS0591 05:28:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
	220	TEST CIRCUIT CARD			
		DELAYS:			
		COMMENTS:			
	230	REPAIR CIRCUIT CARD			
		DELAYS:			
		COMMENTS:			
	240	INSTALL CIRCUIT CARD			
		DELAYS:			
		COMMENTS.			
	250	MASK UNIT			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

A US GOVERNMENT PRINTING OFFICE 1980-748 180/20204

DFS059I 05 WORK CONTROL DOCUMENT (MEDS)

PAGE 1 OF 1V PAGES

DFS059I 05:28:27 TERMINAL STARTED

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
		DELAYS:			
		COMMENTS:			
MAK PN	260	PAINT			
		DELAYS:			
		COMMENTS:			
	270	RETEST			
		DELAYS			
		COMMENTS:			
	280	RELABEL UNIT			
		DELAYS:			

21 FINAL DESTINATION DISPATCH	FUNCTIONAL CODE	22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT/SN
		A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS0591 05:29:41 ...
DFS0591 ...
DFS0591 05:28:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

PAGE 10 OF 10 PAGES

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
		COMMENTS			
	290	SELL			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

☆ U.S. GOVERNMENT PRINTING OFFICE 1990 - 748-180/20204

APPENDIX D

REVISED WCD (STAMPED) FOR ROYAL PRINT PROCESSOR

DFS059I 04:55:07 TERMINAL STARTED
DFS059I 05:29:01 TERMINAL STARTED
DFS991 ... SHUTDOWN
DFS059I 05:28:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED
28024		PRAG		

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO
	KODAK COMMERCIAL MAN[illegible] – T6-2029 / 0B-2029	

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
	6740010420871	
13 SERIAL NUMBER	**14 NOUN**	
XXXXXXXXX	PROCESSOR	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19	20
		CAUTION			
		DESCRIPTION OF INCOMING CONDITION:			
				ITEM DELIVERED TO SUBUNIT	
	10	RECEIVE		SCn SUP	
		DELAYS:			
		COMMENTS:	ARRV	START	COMP
		CAUTION			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

DFS059I 04:55:07 TERMINAL STARTED
DFS059I 05:29:01 TERMINAL STARTED
DFS059I 05:28:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19	20
	20	VISUAL INSP	SUP 1 TEC 1	TEC 1	TEC 1
		DELAYS:			
		COMMENTS:			
	30	DISASSY	TEC 1 TEC 2	TEC 2	TEC 2
		DELAYS:			
		COMMENTS:			
	40	SEPERATE INTO HALVES	TEC 2	TEC 2	TEC 2
TEC 2 SUP 1	SUP 1 SUP 2	DELAYS:			
		COMMENTS:			
PCD	50	SEND TOP HALF TO PLASTIC SHOP & REPAIR	SUP 2 TEC 1	TEC 1	TEC 1

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS059I 04:55:07 TERMINAL STARTED
DFS059I 05:29:01 TERMINAL STARTED
DFS059I 05:28:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7. PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15. DISPATCH STATION	16. PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19	20
TEC A SUP 2	SUP 2 SUP 4	DELAYS:			
	SUP 1 SUP 3	COMMENTS:			
PCO	60	SEND BOTTOM HALF & REPAIRED TOP HALF TO SANDBLAST	SUP 3 TEC X	[illegible]	[illegible]
TEC X SUP 3	SUP 3 SUP 1	DELAYS:			
	SUP 1 SUP 4	COMMENTS:			
PN	70	SEND BOTH HALVES TO PAINT SHOP	SUP TEC E	[illegible]	TEC P
TEC A SUP 4	SUP 4 SUP 1	DELAYS:			
		COMMENTS:			
	80	REPLUMB UNIT.	SUP TEC	[illegible]	[illegible]
		DELAYS:			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS059I 04:55:07 TERMINAL STARTED
DFS059I 05:29:41 TERMINAL STARTED
DFS059I 05:28:27 TERMINAL STARTED

WORK CONTROL DOCUMENT (MEDS)

PAGE 7 OF 13 PAGES

2. JOB ORDER NO	3. QUANTITY	4. PRODUCTION SEC/RCC	5. DATE SCHED	6. DATE COMPLETED

7. PART NUMBER	8. TECH DATA	9. ITEM SERIAL NO

10. MODEL-DESIGN-SERIES	11. STOCK NUMBER	12. OPTIONAL
13. SERIAL NUMBER	14. NOUN	

15. DISPATCH STATION	16. PERF RCC/OP NO	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19. P	20. C
		COMMENTS:			
	90	TEST DRIVE MOTOR		TC	TCC
		DELAYS:			
		COMMENTS:			
	100	REPLACE DRIVE MOTOR		TC	TC
		DELAYS:			
		COMMENTS:			
	110	ASSY HALVES		TC	TC
		DELAYS:			
		COMMENTS:			

21. FINAL DESTINATION		22. COORDINATION/INITIATING RCC SIGNATURE/DATE		23. DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DF50591 05:23:27 TERMINAL STARTED

2. JOB ORDER NO	3. QUANTITY	4. PRODUCTION SEC/RCC	5. DATE SCHED	6. DATE COMPLETED

7. PART NUMBER	8. TECH DATA	9. ITEM SERIAL NO

10. MODEL-DESIGN-SERIES	11. STOCK NUMBER	12. OPTIONAL
13. SERIAL NUMBER	14. NOUN	

15. DISPATCH STATION	16. PERF RCC/OP NO	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19. P	20. Q
	120	DISASSY ROLLER/RACKS		TCC	TCC
		DELAYS:			
		COMMENTS			
	130	SANDBLAST RACKS		TCC	TCC
		DELAYS:			
		COMMENTS:			
	140	ASSY NEW ROLLERS ON RACKS		TCC	TCC
		DELAYS:			
		COMMENTS			
	150	ASSY & INSTALL WATER FOUNTHIN		TCC	TCC

21. FINAL DESTINATION		22. COORDINATION/INITIATING RCC SIGNATURE/DATE		23. DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS0591 05 WORK CONTROL DOCUMENT

DFS0591 05:23:27 TERMINAL STARTED

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20 C
		DELAYS:			
		COMMENTS:			
	160	INSTALL ROLLER RACK ASSY		TCC 1	TCC 1
		DELAYS:			
		COMMENTS:			
	170	WATER TEST		TCC 1	TCC 1
		DELAYS			
		COMMENTS			
	180	REPAIR		TCC 1	TCC 1
		DELAYS			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS059I 05 WORK CONTROL DOCUMENT (MCDS)

DFS059I 05:28:27 TERMINAL STARTED

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19	20
		COMMENTS			
	190	TEST ELECTRICAL BOX		TEC 1	TEC 1
		DELAYS:			
		COMMENTS:			
	200	REPAIR ELECTRICAL BOX		TEC 1	TEC 1
		DELAYS:			
		COMMENTS:			
	210	CALIBRATE ELECTRICAL BOX		TEC 1	TEC 1
		DELAYS:			
		COMMENTS:			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS059I 05 WORK CONTROL ... TERMINAL STARTED

DFS059I 05:28:27 TERMINAL STARTED

2. JOB ORDER NO	3. QUANTITY	4. PRODUCTION SEC/RCC	5. DATE SCHED	6. DATE COMPLETED

7. PART NUMBER	8. TECH DATA	9. ITEM SERIAL NO

10. MODEL-DESIGN-SERIES	11. STOCK NUMBER	12. OPTIONAL
13. SERIAL NUMBER	14. NOUN	

15. DISPATCH STATION	16. PERF RCC/OP NO	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19.	20.
	220	TEST CIRCUIT CARD		TEC	TEC
		DELAYS:			
		COMMENTS:			
	230	REPAIR CIRCUIT CARD		TEC	TEC
		DELAYS:			
		COMMENTS:			
	240	INSTALL CIRCUIT CARD		TEC	TEC
		DELAYS:			
		COMMENTS:			
	250	MASK UNIT	TEC	TEC	TEC

21. FINAL DESTINATION		22. COORDINATION/INITIATING RCC SIGNATURE/DATE		23. DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS0591 05 WORK CONTROL DOCUMENT (MEDS)

PAGE 1 OF 2 PAGES

DFS0591 05:23:27 TERMINAL STARTED

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC/RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20
TEC 1 SUP 1	SUP 1 SUP 4	DELAYS:			
		COMMENTS:			
PN	260	PAINT	SUP TEC	TEC	TEC
TEC B SUP 4	SUP 4 SUP 1	DELAYS: TEC B SUP 4 SUP 4 SUP			
		COMMENTS:			
	270	RETEST	SUP TEC	TEC	TEC
		DELAYS.			
		COMMENTS:			
	280	RELABEL UNIT	TEC 1	TEC 1	TEC 1
TEC SUP 1		DELAYS: TEC SUP			

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE/DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

AFLC FORM 958 NOV 80 PREVIOUS EDITION WILL BE USED

DFS0591 05:28:27 TERMINAL STARTED

2 JOB ORDER NO	3 QUANTITY	4 PRODUCTION SEC RCC	5 DATE SCHED	6 DATE COMPLETED

7 PART NUMBER	8 TECH DATA	9 ITEM SERIAL NO

10 MODEL-DESIGN-SERIES	11 STOCK NUMBER	12 OPTIONAL
13 SERIAL NUMBER	14 NOUN	

15 DISPATCH STATION	16 PERF RCC/OP NO	17 WORK TO BE ACCOMPLISHED	18 MECHANIC	19 P	20 :
		COMMENTS:			
	29C	SELL	SWP RH	SCH	SCH

21 FINAL DESTINATION		22 COORDINATION/INITIATING RCC SIGNATURE DATE		23 DOCUMENT/SN
DISPATCH	FUNCTIONAL CODE	A	C	
		B	D	

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APPENDIX E

EXISTING WORK PLAN

CIVILIAN PERSONNEL POSITION DESCRIPTION	1. NUMBER OF IA's	2. POSITION NUMBER

3. ORGANIZATION	4. POSITION TITLE		
AFLC, OO-ALC, Hill AFB, UT Directorate of Maintenance Missile & Aircraft Systems Div. Production Branch Optical & Elect Recon Sec MAKPRAU	ELECTRONICS MECHANIC		
	5. CLASSIFICATION	6. CLASSIFIED BY	7. DATE
	WG-2604-11		04 Oct 88

8. DUTIES AND RESPONSIBILITIES (Indicate time percentages, where required) Questions concerning the classification of your position should be asked of your supervisor. You may see, upon request, classification standards and guides used in classifying your job. Appeal rights and procedures are explained in Federal Personnel Manual, Chapter 511, Subchapter 6 and AFR 40-512.)

I. INTRODUCTION: Functions assigned to the Optical and Electronic Reconnaissance Section are outlined in the official organizational functional charts of the Ogden ALC. The purpose of this position is to accomplish operational and fault isolation, testing, overhauling, installing, modifying, adjusting, calibrating, and testing complex electronic systems such as aerial reconnaissance systems, infrared systems, lasers, ground information processing systems and sub-systems. The position involves multiple skill disciplines of electronics, precise mechanics, optical and computer sciences.

II. DUTIES AND RESPONSIBILITIES:

1. Provides incoming functional testing and fault isolation, overhauls, modifies, repairs, adjusts, calibrates and functionally tests complex inter-related airborne reconnaissance photographic or ground operational tactical information processing and interpretation systems typified by intricate complex universal camera control systems, aircraft camera parameter system, panoramic camera systems, high speed framing camera systems, photonavigational viewfinder systems, radar recording camera systems, mapping camera systems, laser systems, and infrared systems. The above systems are characterize by the use of a wide range of electronic, precise mechanical, optical and photographic cameras, automatic camera controls, along with ground tactical intelligence gathering data process and retrieval systems.

2. Receives end items along with the appropriate paper work, accomplishes preliminary inspections, performing operational inspections and tests to determine the nature and extent of the repair required to isolate faults. Accomplishes repair or forwards items with data to lower grade employees, testing items in accordance with the acceptable technical data, analyzes electronic, electrical, mechanical, vacuum and optical presentations to ascertain the operational servicability and reliability of the produced equipment. Operates a wide variety of electronic, computing, ATE and dimensional equipment in performing the above duties.

3. Works with higher grade technicians and engineers in development proofing or

MANAGEMENT ENGINEERING TEAM (MET) VALIDATION

THE DUTIES AND RESPONSIBILITIES OF THIS POSITION HAVE BEEN REVIEWED AND ARE APPROVED.	SIGNATURE AND TITLE OF MET ANALYST	DATE 2/Sept 88

GENERAL SKILL			1ST SKILL %	SKILL		SHRED		SUB		2ND SKILL %		SKILL		SHRED		SUB		3RD SKILL		SHRED		SUB	
M	A	Y	4	0	G	D	B	A	V	K	1	J	G	3	0	G	D	B	A	V	K	G	D	H	H	F	M	H	F	S			

9. I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out government functions for which I am responsible. This certification is made with the knowledge that this information is to be used for statutory purposes relating to appointment and payment of public funds, and that false or misleading statements may constitute violations of such statutes or their implementing regulations.

11. POSITION SENSITIVITY		12. FLSA OVERTIME	
	NONSENSITIVE		
X	NONCRITICAL-SENSITIVE		EXEMPT
	CRITICAL-SENSITIVE	X	NON EXEMPT

SIGNATURE AND TITLE OF IMMEDIATE SUPERVISOR	DATE	13. REAUDIT CERTIFICATION (Initials)
	3 Aug 88	DATE
		SUPERVISOR
		CLASSIFIER

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modification of computer software. Provides input to improve reliability of end items under test and reduce cost of repair.

4. Provides training to other personnel by assisting them to perform progressively more difficult tasks and to comprehend the technical problems associated with the specialized, inter-related equipment.

5. Employee will become certified on the systems that are contained within the position description by attending and successfully completing OJT and/or classroom training.

6. Is directly responsible for his/her work accomplished on systems or components where he/she has been duly certified.

7. May be required to train and/or certify work performed by lower grade or non-certified employee.

III. CONTROLS OVER WORK: Receives work assignments from the first level foreman by oral instruction or via work documents. Works independently accomplishing assigned work. Work is accomplished in accordance with approved technical data in the form of technical orders, software, and engineering data. Is responsible for the quality of the work accomplished after being task certified.

IV. OTHER SIGNIFICANT FACTS:

1. Physical Effort: Standing, walking, lifting up to 44 lbs without assistance and heavier loads with assistance. Subject to prolonged sitting and some bending and stooping.

2. Working Conditions: Work is accomplished in a well-lighted, air-conditioned facility. Danger of burns and shock from electrical equipment. May be subject to resonate frequencies, at low decibles, of ultrasonic energy.

3. Subject to travel as a team member or independently. May be required to travel by military or commercial air, government or private auto in performance of TDY or training requirements.

4. Accomplishing the duties of this position, the incumbent must possess the skill and ability to understand and use technical data, some of which may require clarification due to the magnitude of the steps required to achieve tolerances because of the inter-relation of circuit functions. Incumbent must possess the knowledge and ability to utilize electronic test equipment for systematic analysis of problem areas resulting in fault isolation. To accomplish the testing and repair, a thorough knowledge of alternating and direct current transistors, data display, amplification, oscillation, modulation and other electronic theories are required along with the ability to effectively use all test equipment and tools. Proficient use of dimensional, photographic and optical test equipment is required.

5. Incumbent must perform all work in a safe manner using all provided safety equipment. Dexterous hand-eye coordination is required along with depth perception and color identification.

CIVILIAN PERSONNEL POSITION DESCRIPTION

3. ORGANIZATION	4. POSITION TITLE		
AFLC, OO-ALC, Hill AFB, UT Directorate of Maintenance Missile & Aircraft Systems Div. Production Branch Optical & Elect Recon Sec MAKPRAJ	ELECTRONICS MECHANIC		
	5. CLASSIFICATION	6. CLASSIFIED BY	7. DATE
	WG-2604-10		04 Oct 88

8. DUTIES AND RESPONSIBILITIES (Indicate time percentages, where required) (Questions concerning the classification of your position should be asked of your supervisor. You may see, upon request, classification standards and guides used in classifying your job. Appeal rights and procedures are explained in Federal Personnel Manual, Chapter 511, Subchapter 8 and AFR 40-512.)

I. INTRODUCTION: Functions of the above cited organization are outlined in official organizational functional charts. This position is established to perform a full range of tasks associated with the overhaul, modification and testing of a wide variety of airborne imagery sensing systems.

II. DUTIES AND RESPONSIBILITIES:

1. Position involves overhaul, modification, repair and functional testing of airborne photographic systems components which are of moderate functional and design complexity. Examples of equipment worked are: camera bodies, magazines, lens cones, cassettes, controls, viewfinders, infrared components, processor components, and information processing LRUs and SRUs.

2. Mechanic performs functional test on incoming components to determine condition of item. Troubleshoots, replaces, or repairs malfunctioning components and accomplishes technical order modifications.

3. Operates various types of particular test equipment assiciated with each camera system and common test equipment such as oscilloscopes, multimeters, pulse or frequency generators, spectrum analyzers, power meters, optical collimators, vacuum tube voltmeters, and counters.

4. May assist in the complete calibration of cartographic optical systems. Uses selected spectroscopic plates and multi-tube collimators to make plate exposures and process the plates to a specific gamma. Use comparator to measure format and fiducial markings. Performs a variety of nonroutine measurements to a precision of one micron. Assists in mathematically computing equivalent focal length and calibration of positive and negative lens distortion. Computes radial distortion on multiple targets to determine and plot the average on specific distortion curves. Continually monitors calibrator collimators and other peculiar test equipment to assure accuracies to the precision of arc seconds. Refers problems to higher graded mechanics or shop technicians for resolu-

MANAGEMENT ENGINEERING TEAM (MET) VALIDATION

THE DUTIES AND RESPONSIBILITIES OF THIS POSITION HAVE BEEN REVIEWED AND ARE APPROVED	SIGNATURE AND TITLE OF MET ANALYST	DATE
		21 Sep 88

GENERAL SKILL			1ST SKILL %	SKILL	SHRED	SUB	2ND SKILL %	SKILL	SHRED	SUB	3RD SKILL SKILL	SHRED	SUB
M	A	Y	5Ø	GD	BA	VK	1JG	25	HF	MHFS		HHB	

9. I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out government functions for which I am responsible. This certification is made with the knowledge that this information is to be used for statutory purposes relating to appointment and payment of public funds, and that false or misleading statements may constitute violations of such statutes or their implementing regulations.

11. POSITION SENSITIVITY		12. FLSA OVERTIME	
	NONSENSITIVE		
X	NONCRITICAL-SENSITIVE		EXEMPT
	CRITICAL SENSITIVE	X	NON-EXEMPT

SIGNATURE AND TITLE OF IMMEDIATE SUPERVISOR	DATE	10. REAUDIT CERTIFICATION (Initials)
	3 Aug 88	DATE
		SUPERVISOR
		CLASSIFIER

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tion.

5. Provides training to other personnel by instructing them in the performance of progressivley difficult tasks on the assigned camera work loads.

6. Employee will become certified on the systems that are contained within the position description by attending and successfully completing OJT and/or classroom training.

7. Is directly responsible for his/her work accomplished on systems or components where he/she has been duly certified.

8. May be required to train and/or certify work performed by lower grade or non-certified employee.

III. CONTROLS OVER WORK: Receives work assignment from supervisor or higher graded mechanics. Works from technical orders, schematics, engineering standards and blueprints.

IV. OTHER SIGNIFICANT FACTS:

1. Works in an air conditioned building with prolonged sitting. May be required to perform TDY duties, is required to use all safety equipment provided, and work in a safe manner with a knowledge of the hazards.

2. Physical effort includes standing, walking, lifting up to 44 pounds without assistance, bending and kneeling. Good hand-eye coordination is required. Works in a well-lighted, air conditioned building. Works in a controlled area as defined in T.O. 00-25-203.

APPENDIX F

ORGANIZATIONAL BEHAVIOR MODIFICATION (OB MOD) AND ITS IMPLEMENTATION

This appendix explains what OD Mod is, how it should be implemented, and the benefits that can be expected. OB Mod is designed to facilitate change by positively reinforcing behavior. In the article "OB Mod: Meeting the Productivity Challenge with Human Resources Management," which appeared on pages 28-36 of the March 1983 issue of Personnel magazine, there were five steps recommended for the successful implementation of OB Mod. The authors recommended the following steps:

1. **Identify the critical performance behavior.** Everything else stems from this important step. The critical (or desired) behavior must be observable and measurable and usually affects both quality and quantity of performance. It could be something as basic as: "Completes the paperwork on the part before it is sent to the next department."

2. **Measure the behavior identified in the first step.** The company may already be collecting useful data on quality and/or quantity. If not, a measurement scheme must be established, such as tallying the percentage of parts rejected because of poor quality.

3. **Analyze the behavior.** An essential ingredient to this style of behavior modification program is called the antecedent-behavior-consequence (A-B-C) analysis. The antecedents cue the behavior or set the occasion for the behavior to occur, such as a customer making an inquiry. The behavior is what the worker does, while the consequences are the outcomes (such as having a part accepted by another department) that currently maintain the behavior. Sometimes the critical behavior does not occur because something is lacking on the antecedent side. The employee may not have clear goals or the proper training, equipment, or information to perform as desired. Most of the OB Mod program, however, concentrates on the consequences of behavior (such as the administering of rewards).

4. **Intervene to accelerate the desirable performance behaviors and decelerate the undesirable ones**. The major intervention strategy is to give employees feedback on the critical performance-related behavior and positive reinforcement for progress and goal attainment. The article suggests that "the

more immediate, objective, accurate, and positive this feedback is, the more effective it becomes as an intervention for improving performance." Among the many potential forms of positive reinforcement are simple attention and recognition.

5. **Evaluate the intervention to ensure that performance is indeed improving**. This evaluation makes use of the data that were gathered in the second step and tries to be as rigorous as possible.

There is no single method that works best in all areas for establishing an OB Mod program. However, page 375 of the book Management and Organization lists some helpful guidelines to establish a program. The authors identified the following guidelines as being very important:

1. Positive reinforcement is more effective than negative motivators. Punishment is sometimes necessary, but it produces side effects that work against goal-directed behavioral change.

2. Rewards need to follow as soon as possible after the desirable behavior has been performed.

3. Employees need to know which behaviors will be rewarded. Persons who are clearly aware of what is expected of them and of the standards by which their performance is evaluated have built-in feedback systems. They are, therefore, able to make continual judgments about their own work and enjoy maximum autonomy.

4. Behavioral objectives need to be stated in clear and measurable terms.

5. Feedback on performance is vital. Employees need to know what they are doing wrong as well as what they are doing right, although criticism needs to be given privately in order to minimize negative side effects.

6. A need for reinforcement should not be confused with a need for training. Some employees need knowledge rather than reinforcement.

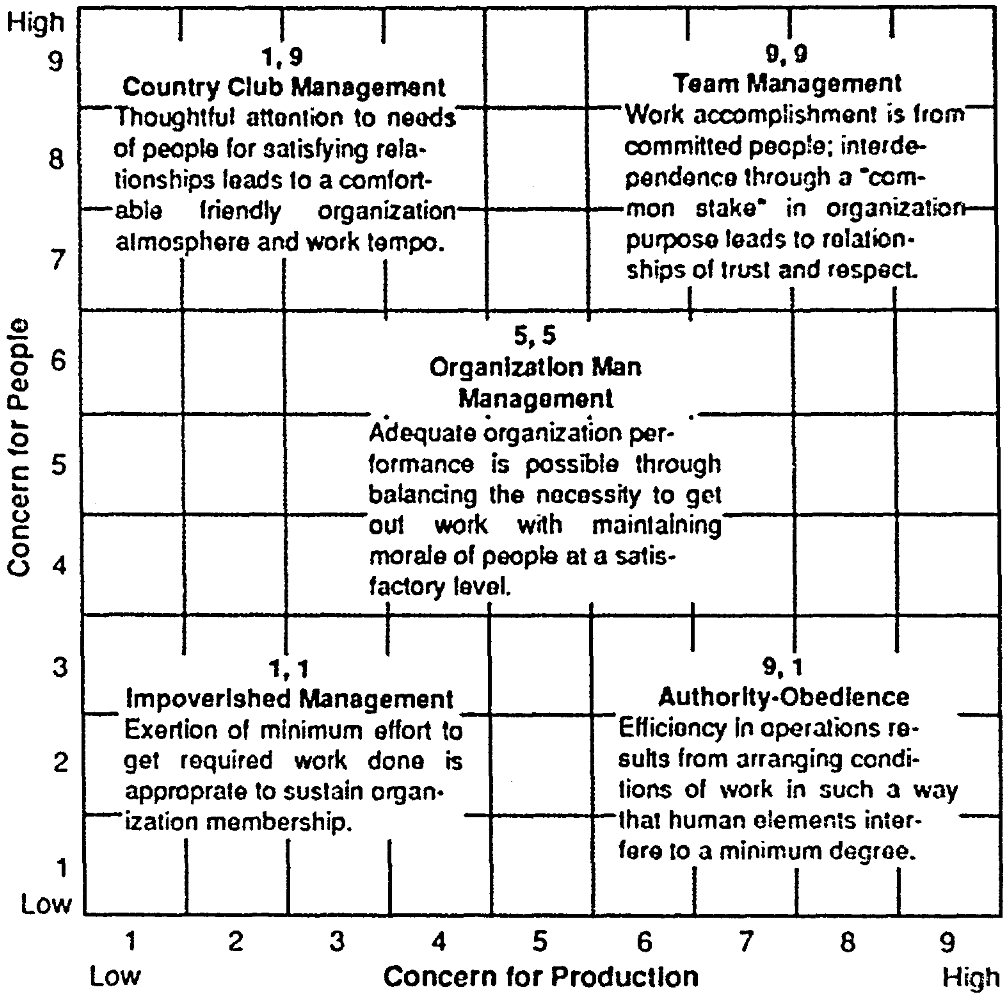
7. Rewards need to be given for movement toward a goal rather than for only the achievement of the ultimate behavioral goal. By rewarding so-called successive approximations, individuals can be moved in the right direction from their starting point (baseline behavior) to their ultimate destination (target behavior).

A very important statement is made in Guideline 3 that bears repeating: "Persons who are clearly aware of what is expected of them and the standards by which their performance is evaluated have built-in feedback systems." The workers will be able to monitor themselves if performance standards are established and the workers are taught how to use them. The IPI engineers do not view the non-engineered standards to be acceptable performance measures since the observations revealed the workers to be attaining these standards with very little effort (refer to Paragraphs 7.1.6 and 7.1.2).

Guideline 6 points out that OB Mod will not succeed in an area where the workers have not been properly trained. Prior to any type of system being established, the workers must be given the required training. The concept of ensuring that there is adequate training for the workers is pursued further in Paragraphs 7.3.3.2 and 7.3.3.6.

The successful implementation of an OB Mod program requires that the workers understand what it is that they are supposed to do. It is not uncommon for workers to misunderstand their job duties. Before a worker is rewarded or disciplined for his job performance, the worker should be surveyed to ascertain that he understands what his job responsibilities are.

For OB Mod to work, the supervisor must be actively committed to making it work. Unfortunately, the supervisors in LIPPP, LIPAA, and LIPAB reflect the same complacency that was observed in the technicians assigned to them. The IPI engineers rated these supervisors as a group, using the Managerial Grid® developed by Blake and Mouton (see following page). Because they are concerned with getting their production out on schedule, but don't do any more work than they need to in order to "get by", the IPI engineers assessed the supervisors as being a (6,1) on the grid.



SOURCE: The Managerial Grid figure from the *The New Managerial Grid*, by Robert R. Blake and Jane Srygley Mouton. Houston: Gulf Publishing Company. Copyright © 1978, page 11.

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The best description that reflects the performance of the RCC supervisors is given on page 24 of the book The Renewal Factor by Robert H. Waterman. He coins the phrase "custodians" to describe those supervisors whose main goal is to make sure that nothing happens "on their watch." Based on the IPI engineers' observations, the MAKPRA supervisors appear to fall into the category of custodians who are content to let operations in the RCC coast along as they have in the past.

Supervisors must be active participants in an OB Mod program, primarily because the successful operation of such a program demands that the administration of awards or discipline be frequent and consistent. The supervisors, due to their day-to-day interaction with the workers, are the best qualified people to provide the positive or negative responses to a worker's behavior. Studies have shown that OB Mod programs can achieve impressive results in terms of improving performance and productivity.

There are two points made in the above summary that the IPI engineers would like to emphasize. The first, as pointed out in step 2, is that a measurement system for collecting useful data on quality and/or quantity must be established. This measurement system is a necessity for any business hoping to survive. The topic of establishing a data collection system is addressed in detail in Quick Fix Plan Paragraph 7.1.2.

The second point is that the methods that can be used to reinforce desirable behavior don't have to be elaborate. Simple methods such as congratulating a worker for a job well done or giving out certificates when a certain level of quality is attained can be used. Cost cannot be used as an excuse to ignore OB Mod.

APPENDIX G

LIST OF ACRONYMS AND ABBREVIATIONS

LIST OF ACRONYMS AND ABBREVIATIONS

A-B-C	ANTECEDENT-BEHAVIOR-CONSEQUENCE
ALC	AIR LOGISTICS CENTER
CRT	CATHODE RAY TUBE
CSR	CONTRACT SUMMARY REPORT
DDB	DATABASE DOCUMENTATION BOOK
FCU	FUEL CONTROL REPAIR UNIT
IOD	INTEGRATED ORGANIZATIONAL DEVELOPMENT
IPI	INDUSTRIAL PROCESS IMPROVEMENT
MDMSC	MCDONNELL DOUGLAS MISSILE SYSTEMS COMPANY
MTBF	MEAN TIME BETWEEN FAILURES
OB MOD	ORGANIZATION BEHAVIOR MODIFICATION
OO-ALC	OGDEN AIR LOGISTICS CENTER
OP	OPERATION
PAT	PROCESS ACTION TEAM
PC	PERSONAL COMPUTER
PCN	PRODUCTION CONTROL NUMBER
PIQTF	PICTURE IMAGING QUALITY TEST FACILITY
PMEL	PRECISION MEASURING EQUIPMENT LABORATORY
RCC	RESOURCE CONTROL CENTER
SA-ALC	SAN ANTONIO AIR LOGISTICS CENTER
SPC	STATISTICAL PROCESS CONTROL
TO	TECHNICAL ORDER
UDOS 2.0	UNIVERSAL DEPOT OVERHAUL SIMULATOR, VERSION 2.0
WCD	WORK CONTROL DOCUMENT
WIP	WORK IN PROCESS